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U.S. WAR DEPARTMENT

TECHNICAL MANUAL

DRIVER SELECTION AND TRAINING

November 10, 1942

CHANGES
No. 1

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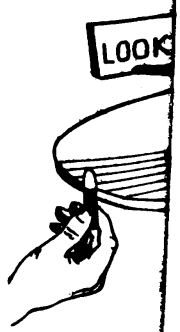

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TECHNICAL MANUAL
No. 21-300

WAR DEPARTMENT,
WASHINGTON, November 10, 1942.

DRIVER SELECTION AND TRAINING

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SECTION I

GENERAL

1. Scope.—*a.* This manual is concerned with—

(1) Selection of men to be trained as military motor vehicle operators.

(2) Training they are to receive.

(3) Examination on the basis of which a military motor vehicle operator's permit is to be issued.

b. Selection of trainees is to be made on the basis of number of men available and the results of a standard interview and testing program.

c. The training program is designed to develop competent military motor vehicle drivers qualified in first echelon maintenance procedure. This program is of general application and not confined to any particular type, make, or model of motor vehicle. It is assumed that the man who has been successfully trained to operate a 2½-ton, 6 x 6, vehicle will be able to operate satisfactorily all or nearly all smaller types of military vehicles. Practical instruction is emphasized throughout.

d. Section III is actually an instructors' guide which presents in extensive detail and logical organization—

(1) *What* should be taught prospective military motor vehicle operators.

(2) *How* these skills should be taught.

e. It is the purpose of section III to bring together in one place all the information needed for purposes of instruction, including relatively simple subject matter. Thus considerable time should be saved by instructional personnel who will not have to locate and search through the many pieces of literature on the various subjects covered. Because of its simplicity and comprehensiveness, this section should be of special help to units in the field where circumstances make necessary instruction by men who have limited experience.

f. In section IV those tests are described which serve both as the final examination for the course and as the examination for the Army motor vehicle operators' permit. These tests deal with skills in vehicular operation and maintenance.

2. Training program adjustments.—*a.* The training program described in section III is a more or less complete one and generally based on a time allotment of 240 hours for training at motor transport schools. However, it is flexible and may be adjusted to meet local conditions. The total time allotted for this program at quartermaster replacement training centers has been designated as approximately 160 hours. Field units may have to make varying adjustments in accordance with the number of men to be trained, number and qualifications of the instructional staff, and facilities and time available. If most of the students in a particular company have been truck drivers in civilian life, the instructional unit dealing with first steps in driving can be given in much less time than the content of this unit suggests. Or, if a company lacks vehicles with winches, the two instructional units dealing with winches would not be utilized.

b. Training should be methodical and standardized so far as possible. The ultimate goal is the creation of motor transport units that can successfully carry out assigned tasks without being a highway menace or a hindrance to other movements. To achieve this goal, similarly trained operators who can work harmoniously as a team are essential.

3. Program scheduling.—Because conditions vary considerably, it is not possible to provide in this manual a standard detailed schedule, nor to specify the number of hours to be devoted to each part of the various instructional units. In this connection it is emphasized that there are limits to the number of persons who can be trained effectively by any one individual, and that these limits will vary in accordance with the particular kind of training job to be done. The personnel charged with instruction will, therefore, take these factors into account

when working out specific advance schedules. In general, instructors should be advised to make as rapid progress as is consistent with satisfactory results.

4. Selection of instructors, assistant instructors, and examiners.—*a.* The effectiveness of any training program depends on the qualifications of instructors and examiners. It is essential, therefore, that every effort be made to select as program personnel the most highly qualified individuals in the organization. For this purpose the following procedures are suggested:

(1) *Selection of instructors.*—The commanding officer, or someone designated by him, should select instructors on the basis of standards such as those outlined below. All the necessary information concerning a candidate may be obtained from official records or through an interview, with the exception of that pertaining to technical knowledge. The latter may be secured through a written test (test No. 2, section IV) that may be given to the entire group of candidates simultaneously in less than an hour. To aid officers in rating candidates and also to insure uniformity in rating procedures, Table I has been prepared describing the requirements and indicating the method of rating.

(2) *Selection of assistant instructors.*—In general it is desirable to select as assistant instructors individuals who come close to meeting the standards suggested for instructors. Frequently, however, such personnel will not be available in addition to those qualified as instructors. In such cases instructors should, during the actual training, be on the alert to single out superior students who can be developed as assistant instructors. Those who learn quickly can be assigned to help speed up the learning of those who are slow in making progress. The instructor should also be on the lookout for students who have had special types of experience. For example, the instructor may delegate to a student who has had extensive experience in driving trailer-combinations the task of instructing men in the operation of these vehicles.

(3) *Selection of examiners.*—The value of the final examination in sorting out men unqualified to drive will depend largely on the competence of examiners. Under the supervision of a commissioned officer, qualified instructors may serve as examiners. Following are suggestions for their selection.

(*a*) Use as few examiners as possible. Each examiner will become better trained since he will have more men to examine.

(*b*) Those men should be chosen as examiners who are interested in testing, and who understand fully the purpose and nature of every test.

TABLE I.—*Evaluation chart for selection of instructors of military motor vehicle operation*

In the Evaluation column the examiner should write "S" for Satisfactory and "U" for Unsatisfactory on the blank lines opposite requirements. It is suggested that a candidate be recommended if no "U" rating appears in this Evaluation column.

SUGGESTED REQUIREMENT	BACKGROUND OF CANDIDATE	EVALUATION
1. MOTOR VEHICLE OPERATOR'S PERMIT (U. S. ARMY)	Has permit ____. Does not have permit ____.	_____
2. EDUCATION AND EXPERIENCE Graduation from a senior high school.	Draw a circle around the number that indicates candidate's years of high school education: 0 1 2 3 4 Years of college education: 0 1 2 3 4	
Four years full-time paid experience in motor vehicle operation, maintenance, or both or Two years supervisory experience or teaching in the fields of motor vehicle operation, maintenance, or both.	Write in the proper spaces below the number of years of the candidate's experience: General / Supervision / Teaching Operation ____ ____ ____ ____ Maintenance__ ____ ____ ____	
NOTE.—In evaluating the education and experience of the candidate, the examiner should bear in mind that deficiencies in education can be compensated for by additional experience, and vice versa. For example, if a candidate has only two of the four years required experience but attended an engineering college for two years, he may be considered acceptable. It is up to the examiner to determine whether or not a candidate has an equivalent combination of education and experience.		_____
3. TECHNICAL KNOWLEDGE A passing score on an objective written examination (passing grade is 80%).	Candidate's score ____	_____
4. PERSONALITY (as indicated in interview with an officer)		
Clear and coherent speech		_____
Pleasing appearance and bearing		_____
Emotional stability		_____
Leadership qualities		_____
Ability to work with others		_____
Perseverance		_____
Ability to present technical information simply		_____
NOTE.—The candidate must receive an "S" rating on all the above, in order to receive an "S" rating on Personality.		_____
5. INTELLIGENCE (official rating, if any is available) A grade of at least III (average intelligence) on the Army general classification test, described in AR 615–25.	Candidate's grade on the Army general classification test_____	_____

Candidate_____(name) is Satisfactory / Unsatisfactory (cross out term that doesn't apply) for this assignment.

Date: _____ Signature of examiner: _____

(*c*) Examiners should have normal vision in each eye.

b. Following are suggestions for insuring the quality of the examination:

(1) If possible, examiners should be provided with training and practice in the work which they are to perform.

(2) Examiners should occasionally test the same driver and then compare his ratings. This would tend toward greater uniformity.

(3) The officer in charge should make frequent inspections while tests are in progress. Constant supervision is necessary to prevent the lowering of standards by examiners.

c. Examiners must know and follow in detail the methods prescribed for giving examinations. While the examination may have to be modified in some aspects to suit local conditions, individual methods will not be used by different examiners at the same location.

SECTION II

PRELIMINARY TESTING PROGRAM—SELECTION OF MEN FOR TRAINING

5. General.—*a*. Individuals vary widely in physical and mental abilities. There are some so poor in abilities related to safe and skillful driving that it is advisable to eliminate them as Army drivers. Steps must be taken to weed out such individuals *before* time and effort are expended in attempting to train them to drive an Army vehicle, and *before* they have had opportunity to demonstrate their ineptitude at the cost of valuable equipment and vital manpower. The aptitude tests considered to be the most significant for the purpose of selecting men to be trained as Army drivers are described in the paragraphs below.

b. Only a limited amount of time will usually be available for such testing. Therefore, the procedures have been made as simple as possible and construction of special equipment has been held to a minimum. It is essential, however, that specifications for test devices and testing conditions be followed very closely.

c. An interview, tests of visual acuity and side vision, and a driver-information test are prescribed for initial selection. Their use and the minimum standards in each case are described in paragraphs 6 and 7 together with optional tests that may be given at the discretion of

the commanding officer in event that additional information about the driving aptitude of his men is desired.

6. Interview.—*a. General.*—Useful information concerning each man under consideration can be obtained through a carefully conducted interview. The person being interviewed must understand that the purpose of the interview is to help place him in work for which he is best suited. Emphasize the importance of truthful answers. During the course of the interview note any evidence of extreme nervousness, poor hearing, or other abnormal conditions.

b. Instructions to enlisted men.—"You are going to be asked a number of questions about yourself and your driving experience. Answer every question as accurately as you can. *Answers dealing with your record of accidents and violations will be checked by official records, so be honest.* Your answers will be used to help place you in work for which you are best fitted." The following questions will be asked. On the basis of the answers furnished, the information will be recorded on copies of the Driver Qualification Form at the end of this section.

(1) About how many years of experience have you had driving a passenger car?

(2) About how many miles did you drive during the 12 months prior to your induction into the Army?

(3) How many years of experience have you had driving a passenger bus?

(4) How many years of experience have you had driving a truck of ½-ton or greater capacity?

(5) Have you ever driven a truck with front-wheel drive?

(6) Have you ever driven a trailer combination?

(7) How many accidents have you had in which someone was injured or in which the property damage exceeded twenty-five dollars?

(8) About how many times have you been responsible for traffic violations while driving?

(9) How many years of experience have you had as an automobile mechanic or in related work?

(10) How many years of schooling have you completed?

(11) How tall are you?

(12) What is your weight?

(13) Do you think your general physical condition is normal, better than normal, or below normal?

(14) Do your eyes ever trouble you much; do you have difficulty in seeing clearly at times?

(15) Do you wear glasses while driving?

(16) Do you ever have any serious trouble hearing clearly?

(17) Do you have any (other) outstanding physical defects that you know of?

(18) Have you any personal objection to becoming a military motor vehicle operator? (If so, explain.)

c. Use of information obtained (minimum standards).—(1) If the number of men available for training as military motor vehicle operators does not exceed the number needed, then the sole purpose of the interview is to locate any individual who may have serious physical shortcomings. Doubt concerning the individual's vision should be followed up by the tests of visual acuity and side vision described in paragraph 7. Cases of extreme nervousness, excitability, or doubtful general health should be referred to the company medical officer for careful examination.

(2) In situations where the number of men available for training exceeds the number needed, the first process of selection should be to weed out individuals who do not meet the following minimum standards of experience and training:

Driving experience—1 year.
Mileage during last year of civilian driving—4,000 miles.
Driving accidents—none during past 3 years.
Education—completion of fourth grade in school.

(*a*) Persons who meet these standards must also pass the basic tests of driver information, visual acuity, and side vision described in paragraph 7.

(*b*) If the number of persons who pass all four examinations (interview and basic tests) exceeds the number needed for training, select those with the best driving record. (Consider amount and type of experience and record of accidents and violations.)

(*c*) Individuals with special experience, for example, operation of trailers, may be considered for special training or for assistants in instruction.

7. Basic tests.—The following basic tests are given in situations where the number of men available for training exceeds the number needed. Before being accepted for training, an individual must not only pass all three tests, but also satisfy the officer conducting the interview described in paragraph 6 that he is generally acceptable for training purposes.

a. Test of visual acuity.—(1) *Purpose.*—This test is to insure that no one is selected for training who is unable to see clearly enough for safe and effective operation of a vehicle.

(2) *Equipment.*—Materials needed for this test include the Snellen

chart (fig. 1, see back of manual) and, if possible, two 25-watt lamps in reflectors. The chart should be kept clean and covered when not in use.

(3) *Procedure.*—(*a*) Tear out the chart and mount flat on white cardboard. Tack the cardboard to a flat wall surface so that the next to the last line of letters (P H N U T D Z) is at eye level. Place two lamps, one on each side, about 2 feet in front of the chart and facing it. Adjust the lighting to eliminate glare and secure uniform illumination of the chart. No bright lights or surfaces should be near the chart. The testing room should have less illumination than the chart itself.

(*b*) Have the subject stand exactly 20 feet away from the chart and directly in line with it. Ask him to cover his left eye with a card. Then, with his right eye, read the letters on the chart as far down as he can. Make note of the last line he is able to read with not more than one error. Have him repeat this procedure with the left eye after he has covered his right eye. If he wears glasses, test him with his glasses on. The test of visual acuity should be given by the company medical officer.

(4) *Scoring.*—(*a*) The score for each eye is indicated by the number above the last line he is able to read with not more than one error. The *minimum* standard for each eye is the completely correct reading of the "50" line (P T X Z).

(*b*) Trainees who require the use of glasses to meet the minimum standard should have their operator's permit stamped "Not Valid Unless Wearing Glasses, Except In An Emergency."

b. Test of side vision.—(1) *Purpose.*—This test is to determine how well an individual can see on either side while looking straight ahead. Good side vision is particularly important in driving through intersections and in passing other vehicles or objects. Poor side vision is generally indicative of more or less serious eye disorders.

(2) *Equipment.*—Necessary equipment includes the simple device shown in figure 2 and a piece of white chalk or a similar object. The device itself is made of ¼-inch plywood board; heavy cardboard may be used as a substitute.

(3) *Procedure.*—Have the subject hold this board horizontally against his face with the center notch at the bridge of his nose. (He should be standing so that light falls more or less directly upon the top of the test device.) Tell him to keep his vision focused on the word "Look" about 2 feet away from his eyes. Then, standing directly in front of the subject, slowly move the piece of chalk, beginning at his left ear, along the circumference of the board until he can notice it. (In

moving the piece of chalk, the hands and arms should be concealed under the device.) The point at which the subject first sees the moving object represents the extent of vision to the left side. The edge of the board (see fig. 2) is marked in degrees so that a numerical value can be

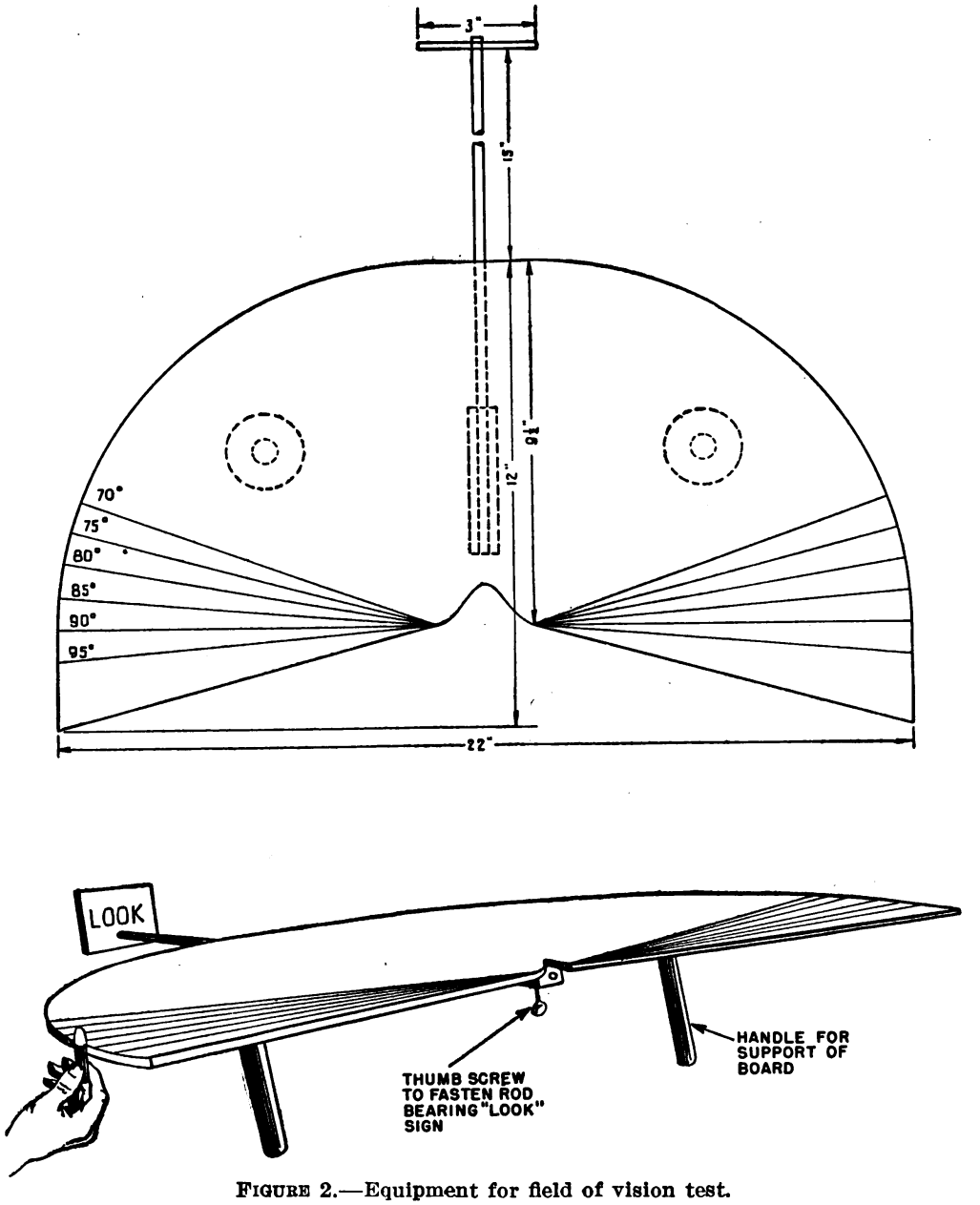


FIGURE 2.—Equipment for field of vision test.

assigned quickly to the subject's side vision. The same testing procedure is then followed on the right side. *Make sure that during the test the subject does not shift his eyes to the side.* By watching his eyes carefully, it can be determined whether or not he does shift them. It is desirable to repeat the test at least twice on each side to make sure

that the score is reliable. This test should be given by the company medical officer.

(4) *Scoring.*—The score for each side is the average score for the number of trials given. The recommended minimum standard is a score of 75° on each side.

c. Test of driver information.—(1) *Purpose.*—This test is to provide information concerning each man's knowledge of driving principles and practices. This knowledge reflects to some extent an individual's skill in this field.

(2) *Materials.*—The written test at the end of this section can be given to an entire group of candidates simultaneously in considerably less than an hour. Questions pertaining to Army regulations and practices are not included since this test is to be used primarily in selecting men who have not had training in Army vehicle operation. If the test cannot be mimeographed, several typewritten copies may be made and one given to each individual with the instruction that he write his answers on a separate piece of paper. In this way, the test may be used a number of times.

(3) *Procedure.*—Read aloud and, if necessary, explain the instructions on the first page of the test. Point out that there is no time limit but urge the men not to take too long. Take precautions to prevent copying by spacing men and, if necessary, using monitors.

(4) *Scoring.*—The correct answers are listed on the page following the test. Scoring of a test paper will be speeded up considerably if the first column of the answer key is placed alongside the individual's answers on the first page of the test. The number of correct answers on that page can then be determined immediately. Use this same system for scoring all pages. The recommended minimum standard is 25 of the questions answered correctly.

8. Optional tests.—Any or all of the following tests can be given at the discretion of the commanding officer in event that additional information concerning the driving aptitude of his men is desired. Together with those previously described, these tests are the most worthwhile for military purposes. Therefore, no additional or substitute tests should be employed at present.

a. Test of color vision.—A comparatively simple test may be given to determine color-blindness. A pile of red, yellow, green, blue, and orange pieces of paper should be mixed together. The subject should be required to pick out and separate into two piles the red and green pieces. Fortunately, a person who is red-green color-blind can usually distinguish between red and green colors, but they may appear to him as different shades of gray. Consequently an individual who is red-

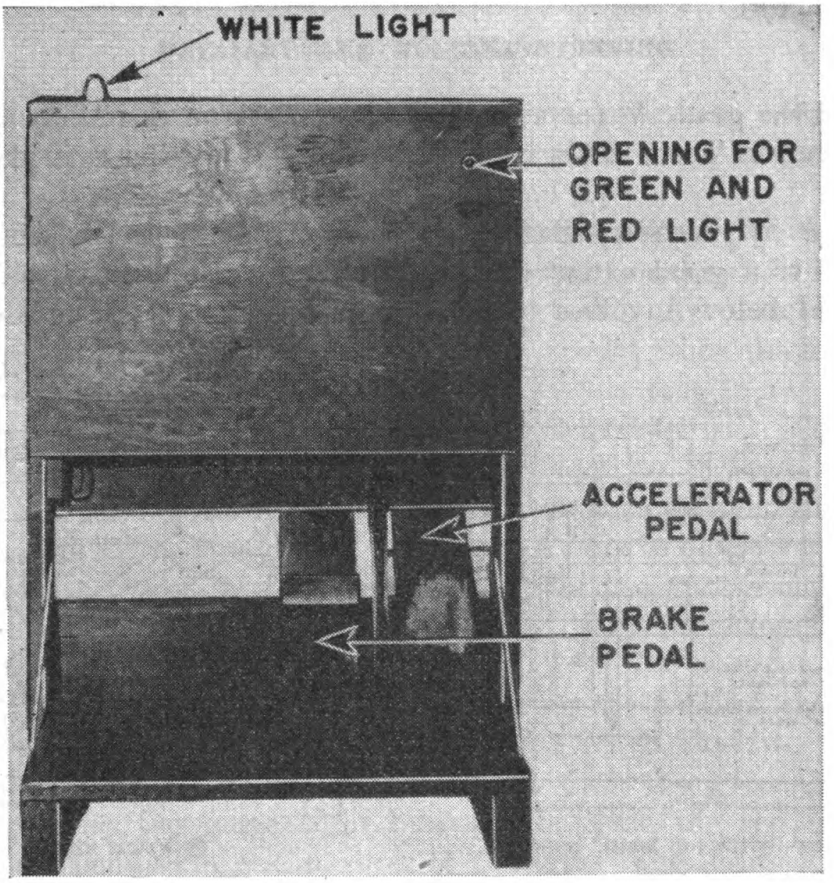
green color-blind is not greatly handicapped in his driving, particularly if he is aware of the condition, makes it a point to watch carefully the actions of other motor vehicle operators, and learns the relative position of red and green traffic lights in various localities.

b. Test of night vision.—(1) Studies indicate that the usual test of clearness of vision (visual acuity) is not necessarily an indication of how well a person can see in the dark. Measurement of night vision may be made by testing men outdoors on a clear night, before the moon has appeared, as follows: Have constructed a black target on which there is a movable white cardboard stripe, 6 by 24 inches. This target should be mounted on a post at one end of a level field, 5 yards wide and 40 yards long, away from all artificial light. Distances from the target should be marked off at 5-yard intervals. After the subject has been kept away from all artificial illumination for 20 minutes prior to testing, so that his eyes may become adapted to the darkness, he should start from the far end of the field, at the 40-yard mark, and walk slowly toward the target. The distance at which the subject is first able to identify the position of the white stripe correctly is noted. While the subject is walking back for another trial, the position of the white stripe is changed. Several trials are made. Correct recognition should take place at an average distance of not less than 17 yards (preferably at least 20 yards) from the target. It is necessary, however, that the condition of illumination be controlled as indicated, otherwise these standards cannot be used.

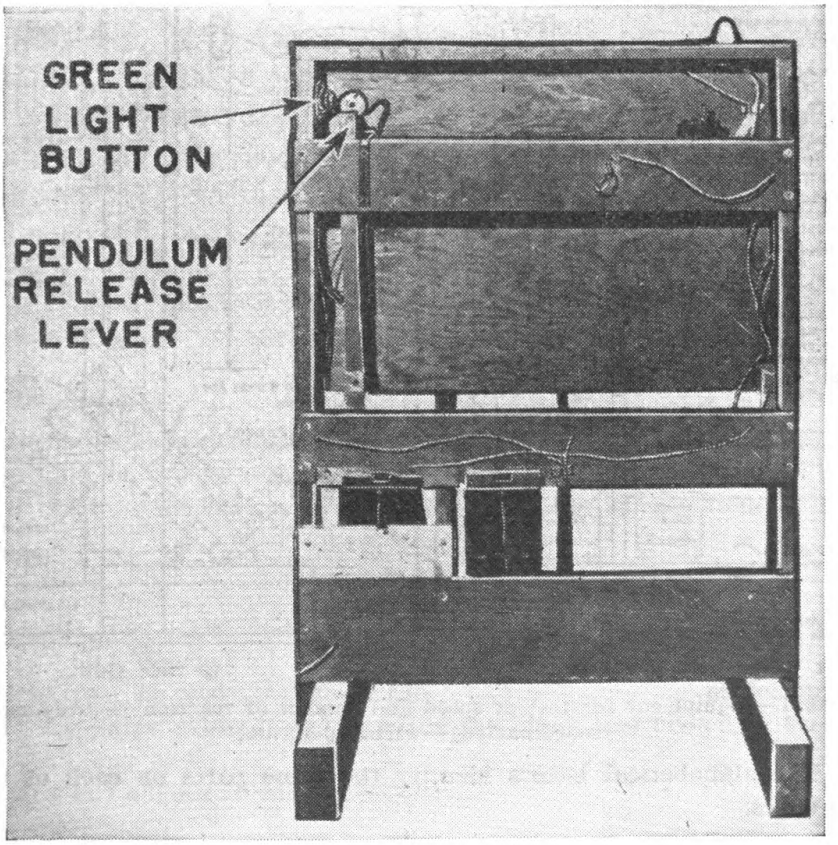
(2) If a man evidences some degree of night blindness and his eyes are not diseased, he may still become an expert all-around driver. Vitamin A tablets may correct his condition within several days. Foods such as carrots, butter, eggs, and spinach are rich in vitamin A and can be very beneficial in curing night blindness.

c. Test of blood pressure.—A much needed test is one of general physical fitness and ability to withstand fatigue, as military motor vehicle operators are subject to considerable strain. In this connection, research and clinical medicine indicate that high or low blood pressure, in general, is undesirable for purposes of vehicular operation involving long hours or other strenuous conditions. A systolic blood pressure persistently below 105 mm or above 145 mm may be considered abnormal for the age range of the great majority of enlisted men. Army medical officers can provide the necessary information.

d. Test of intelligence.—Persons very low in intelligence are unlikely to respond successfully to emergencies on the road. It would be wise to exclude from driver training anyone who has



① Front view.

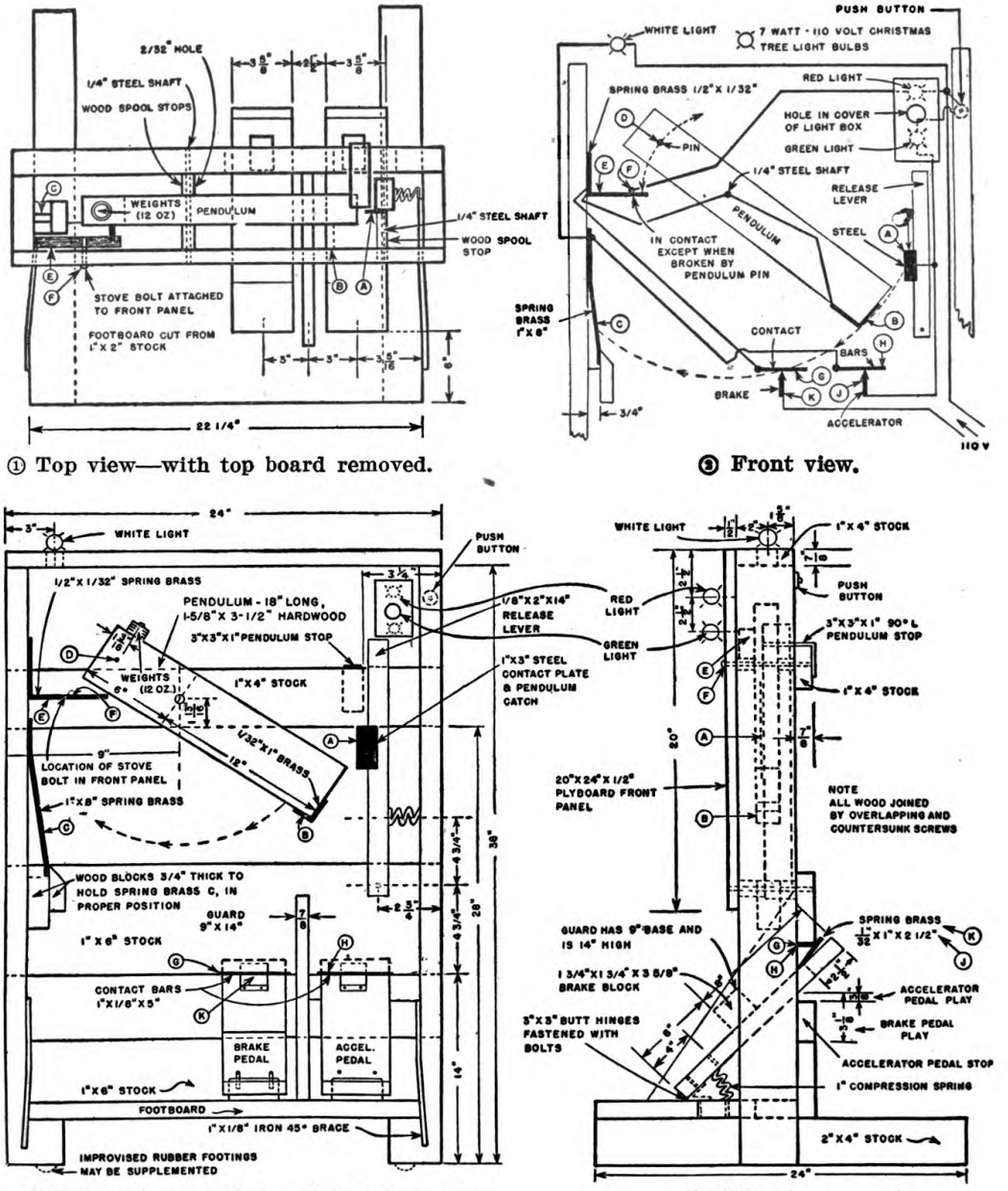


② Back view.

FIGURE 3.—Reaction testing device.

received the grade V (or a score of 60 or less) on the Army General Classification Test. This information may be available in company records.

e. Test of reaction.—Safe and effective driving in an emergency depends to a great extent on speed and control of action. The test described below involves to some degree factors such as alertness,



① Top view—with top board removed.

② Front view.

③ Front view—with panel board removed.

④ Side view.

FIGURE 4.—Equipment for test of speed and control of reaction (neuromuscular coordination)—wiring diagram.

NOTE: The alphabetical letters identify the same parts on each of the four different views.

quick decision, and self-control. The test apparatus, however, is relatively complicated, and it is likely that for many organizations this test will be impractical. (See figs. 3 and 4.)

(1) The subject should be seated in front of the test device. His right foot should be on the accelerator pedal and his left foot stationary on the floor at the left of the brake pedal. He should be told not to remove his foot from the accelerator pedal when the examiner flashes the green light. If he does remove his foot in response to the green light, the white light will automatically flash. This indicates an error. He should be told to respond to the red light by taking his right foot off the accelerator and depressing the brake pedal as quickly as possible. If the subject fails to depress the brake pedal within the six-tenths of a second after the appearance of the red light, then the white light will flash. This indicates that his reaction is slow.

(2) The examiner should be seated facing the back of the device. His left hand should be in a position to reach the two controls easily, but hidden from the student. To flash the green light, he merely pushes the green light button. To flash the red light, he pushes the pendulum release lever to the left. The lights should be flashed in the following sequence: (1) red, (2) green, (3) green, (4) red, (5) red, (6) green, (7) green, (8) green, (9) red, (10) red, (11) green, (12) red, (13) green, (14) red. This provides seven trials with the red, and seven with the green. The intervals between successive lights should vary from 5 to 15 seconds. If the test is used to reject men outright, such rejection should be made if an individual does not once respond fast enough to the red light, and if he does not respond correctly to the green light at least twice.

DRIVER INFORMATION TEST NO. 1
(For initial selection)

INSTRUCTIONS

Read each question carefully. Select the best answer to each question. On the blank line to the left of the question number, write the letter preceding what you think is the best answer. Notice how the sample item is marked.

Sample item

A
———100. The right foot is used to step on the brake pedal. (A) True (B) False

The right foot *is* used to step on the brake pedal, so the statement is true. Therefore the letter A has been placed on the blank line preceding the question number.

Mark only one answer to each question.

QUESTIONS

———1. Under normal operation, the hand throttle should be closed.
(A) true (B) false

———2. In driving any car for the first time, it is most important to check the—
(A) shackles for possible wear (B) headlights
(C) brakes (D) reverse gear

———3. If the approaching driver does not dim his lights, you need not dim yours.
(A) true (B) false

———4. Most automobile skids are the result of—
(A) fate and cannot be prevented
(B) too much snow or ice on the road
(C) overinflated tires
(D) driving too fast for the road condition

———5. If a trolley is discharging passengers where there is no safety zone and you drive up from behind the trolley car, you should—
(A) pass to the left. (B) sound horn and pass slowly on right
(C) stop back of the nearest door of the trolley car

———6. It is permissible to pass another vehicle at—
(A) an intersection when there is no other traffic
(B) on hills if there is a three-lane road
(C) on a four-lane highway

———7. When you descend a steep hill, the ignition switch should be cut off to increase the braking effect of the engine.
(A) true (B) false

———8. You may drive to the left of the center of the highway when—
(A) approaching the crest of a hill (B) approaching within 100 feet of any bridge (C) within 100 feet of an intersection
(D) overtaking another vehicle

———9. When you intend to turn or stop, the law does not require you to give a hand signal unless there is a vehicle following yours.
(A) true (B) false

———10. If a driver seriously injures a pedestrian who is legally at fault when struck, the driver does not have to make out an accident report.
(A) true (B) false

———11. Although automobiles are built today to run at high speeds, it still costs more to drive at 50 miles per hour than at 35 miles per hour.
(A) true (B) false

———12. When you are driving down a long hill, the clutch pedal may be held down if the gearshift lever is left in high position.
(A) true (B) false

———13. You are driving on a two-lane road when a driver approaching you attempts to pass a car ahead of him without sufficient space ahead. You can help reduce the danger by—
(A) reducing speed (B) sounding horn (C) increasing speed
(D) keeping speed constant

———14. New nonskid tires have done away with the danger of skidding on wet pavements.
(A) true (B) false

———15. If your right wheels get on a rough shoulder of the road, you should first—
(A) turn the steering wheel quickly to get back on the road (B) steer straight and slow down gradually (C) slam on the brakes (D) speed up

———16. With headlights in good condition, night and day speeds may be the same.
(A) true (B) false

———17. When meeting glaring lights at night, it is best to—
(A) look straight ahead (B) close the eyes for a second (C) watch the right shoulder of the road (D) look directly at the approaching lights

———18. It requires the same distances to slow down from 60 miles per hour to 50 miles per hour as from 40 miles per hour to 30 miles per hour.
(A) true (B) false

———19. When stopping a car while driving in low, you should first—
(A) depress the clutch (B) apply the brake
(C) put the gear shift in neutral

———20. The upper headlight beams should be used—
(A) When meeting other cars (B) for city driving
(C) when approaching cars fail to dim (D) on country roads

———21. While on a slight grade waiting for a traffic signal to change you should use the clutch to keep the vehicle from rolling back.
(A) true (B) false

———22. It is desirable to depress the clutch pedal before using the starter button, even if you have checked the gearshift lever for neutral position.
(A) true (B) false

———23. In bringing a vehicle to a complete nonemergency stop from a speed in excess of 30 miles per hour, you should depress the—
(A) clutch and brake pedals at the same time
(B) clutch pedal first and then depress the brake pedal
(C) brake pedal only
(D) brake pedal first and depress the clutch pedal later

———24. You are driving on a snow-covered road and have to make a stop quickly. The best way to do this is to—
(A) slam the brakes on hard (B) roll down the window and signal (C) turn off the ignition and apply the hand brake (D) pump the brake pedal

———25. When driving in a fog at night, you will obtain the best visibility by using—
(A) the upper headlight beam (B) the lower, or passing, headlight beam (C) the parking lights (D) no lights at all

———26. In going downhill it is permissible to—
(A) disengage the clutch (B) put the transmission in neutral
(C) use high gear (D) turn off the ignition

———27. Who has the right-of-way if you are approaching an intersection where there is no traffic light or officer and a pedestrian is on the cross-walk?
(A) you have (B) the pedestrian has (C) you have if you sound your horn (D) neither has

———28. Which is the most dangerous place to pass?
(A) just before reaching a hillcrest (B) just over a hillcrest (C) going downhill 150 feet beyond a hillcrest (D) at the bottom of a hill

———29. The left arm held downward and outward at a 45° angle is a signal for—
(A) a right turn (B) a left turn (C) slowing down
(D) the driver behind to pass

———30. If you are involved in an accident, you should first—
(A) notify the police (B) assist the injured (C) get the names of the witnesses (D) get the name of the other driver

———31. A driver should be more attentive and cautious at night than in the daytime because—
(A) he may fall asleep (B) it is easier to get lost at night (C) visibility is poor (D) more careless drivers are on the road

———32. The best way to keep your attention on driving is to—
(A) refuse to talk with other persons with you (B) think of the accidents which have occurred because of lack of attention to driving (C) always try to make your driving a full-time job

———33. The oil gage indicates—
(A) The amount of reserve oil (B) the pressure at which the oil pump is pumping oil (C) how much oil is in the transmission (D) the viscosity of the oil in the engine

———34. The left arm held straight out horizontally is a signal for—
(A) a right turn (B) a left turn (C) slowing down
(D) stopping

———35. Over-inflation of tires increases traction.
(A) true (B) false

———36. The hand signal for slowing down is the same as for stopping.
(A) true (B) false

———37. Generally the safest drivers are those who—
(A) have the best vision (B) have the quickest reaction time (C) do the most driving (D) adjust their driving to driving conditions

———38. In backing down a hill, the driver should put the vehicle in neutral.
(A) true (B) false

———39. You should release the hand brake—
(A) after starting the engine (B) after depressing the clutch pedal and placing the gearshift lever in reverse or low (C) after depressing the clutch pedal and before shifting (D) after the car has gained slight momentum forward or backward

40. When stopped at a red traffic signal and waiting for the green light, you should—
(A) have the gear shift in low or neutral (B) put on the hand brake (C) put the car in motion on the amber light

41. A driver entering a public highway from a private driveway should—
(A) yield the right-of-way to all approaching vehicles
(B) sound horn and proceed cautiously
(C) look both ways, sound horn, then drive into the street

42. Where there is a center line, left turn should be made from the—
(A) lane next to the right-hand curb (B) the lane to the right of the center line (C) the lane with least traffic

43. A driver ready to make a left turn when the light turns green should—
(A) hurry to turn before oncoming traffic gets in the way (B) signal and slowly make the turn (C) turn only when oncoming traffic does not constitute a hazard

44. The automatic choke on newer cars was devised so that drivers would not have to let the motor run several minutes to warm up in cold weather.
(A) true (B) false

45. If, because of a weak battery, a vehicle is towed for starting, it should be placed in—
(A) first gear (B) second gear (C) high gear
(D) front-wheel drive

46. A driver with unusually fast reaction ability might invite rear-end collisions by stopping too suddenly.
(A) true (B) false

47. A rear-view mirror can be relied upon for a complete view of what is behind your car.
(A) true (B) false

48. Which of the following is the most helpful in avoiding traffic accidents?
(A) learning the traffic laws (B) learning what makes an automobile run (C) learning good driving habits (D) developing a sense of self-confidence

49. At night a driver can see a pedestrian most easily on a road made of—
(A) asphalt (B) dirt (C) brick (D) concrete

50. If two vehicles approach an intersection at right angles at the same time, which one has the right of way?
(A) the vehicle on the left (B) the vehicle traveling the faster (C) the vehicle on the wider street (D) the vehicle on the right

TEST ANSWERS

Page 16	Page 17	Page 18	Page 19
A 1.	B 14.	B 27.	A 40.
C 2.	B 15.	A 28.	A 41.
B 3.	B 16.	C 29.	B 42.
D 4.	C 17.	B 30.	C 43.
C 5.	B 18.	C 31.	B 44.
C 6.	A 19.	C 32.	C 45.
B 7.	D 20.	B 33.	A 46.
D 8.	B 21.	B 34.	B 47.
B 9.	A 22.	B 35.	C 48.
B 10.	D 23.	A 36.	D 49.
A 11.	D 24.	D 37.	D 50.
B 12.	B 25.	B 38.	
A 13.	C 26.	B 39.	

DRIVER QUALIFICATION FORM FOR INITIAL SELECTION

Name ---------- Date----------, 194----

Serial number ---------- Age ----------

Organization ---------- Height ------ ft. ----- in.

Education (years completed)---------- Weight ---------- lbs.

Mileage driven past 12 months: ----------

Driving Experience

Vehicle	*Size and type*	*Type of driving*	*Years*
Pass. car	----------	----------	--------
Bus	----------	----------	--------
Trailer	----------	----------	--------
Truck	----------	----------	--------

Total violations -------- Total accidents ----------

Questionable Conditions Noted in Interview

1. Vision (See questions 44 and 15) _____

_____

_____

2. Hearing (See question 16) _____

_____

_____

3. General physical conditions (See questions 13 and 17) _____

_____

_____

4. Attitude (See question 18) _____

_____

_____

5. Others (list here): _____

_____

_____

Basic Test Scores

(Write score and indicate by check mark if satisfactory)

Glasses worn:

For driving? _____

For test? _____

Visual acuity:

Right eye _____

Left eye _____

Side:

Right eye _____

Left eye _____

Driver information _____

Optional Test Scores

(Write score and indicate by check mark if satisfactory)

Intelligence _____

Night vision _____

Blood pressure _____

Color vision _____

Reaction:

Time _____

Control _____

SECTION III

MILITARY MOTOR VEHICLE OPERATORS' COURSE

(Instructors' guide)

FOREWORD TO INSTRUCTORS

9. Purpose.—*a.* You are an instructor. You should know a great deal about the subject which you are going to teach. Your instruction should be made as effective as possible, so that students will gain information easily, retain it, and become skillful.

b. The instructors' guide is designed to save trouble by outlining the subject matter and methods of instruction which have proved effective, and by giving hints which will aid in presenting each subject in a logical sequence and an easy-to-understand and effective manner.

10. Set-up of guide.—*a.* This guide has been organized into four major units:

Unit 1. Introduction to course.

Unit 2. Physical and mental qualities affecting the operation of motor vehicles.

Unit 3. First echelon preventive maintenance.

Unit 4. Technique of driving.

b. The two largest units (3 and 4) deal with vehicle maintenance and technique of driving. These are broken down into numerous subunits. At the beginning of each subunit its objective is described, information is given concerning the time needed to complete instruction on the subject, the place or places where instruction is to be undertaken is listed, as are the equipment and facilities necessary, helpful materials and teaching aids, necessary personnel, and printed source of information for instructors and assistant instructors.

c. The introductory matter is followed by the guide proper, which consists of—

(1) A list of the specific subjects covered throughout the subunit.

(2) A series of logically organized statements concerning the specific content to be presented and the method of presentation (major body of the instructors' guide). For example, in Unit 4H, one of the subjects listed is "Putting on chains." Under Instruction appear details of the three major steps to be followed by the assistant instructor in demonstrating the proper method of applying chains. In numerous places, charts, diagrams, or photographs have been inserted for the guidance of the instructor or assistant instructor in covering a particular subject.

11. How to use the guide.—This guide is not made up of a lot of rules. It contains many standard procedures and many suggested procedures. If these procedures are followed closely, it is expected that instruction will be effective. However, an instructor may also make use of his own experience. In teaching some units he may not be able to follow the guide closely because of inadequate facilities, equipment, or personnel. In such cases he should use his own best judgment as to how to modify the instructional procedure. Always keep in mind that good teaching is an art. Seldom, if ever, are any two situations, any two students, or any two instructors exactly alike.

12. To refresh the memory.—*a.* Even though you know your subject well, if you haven't been handling it recently you may have

become a bit rusty. Furthermore, changes and improvements are taking place all the time. Therefore, before each lesson assure yourself that you know your subject, using such reference books and other texts as are necessary.

b. When you are teaching, you may occasionally get caught on a point about which you are not sure. In such a case don't bluff. Tell the class you don't know but that you will find out—then find out and give the answer at a later session. No one is expected to know everything. If you usually know your subject, your reputation can stand an occasional admission that you are not informed on some point. However, you can't afford a reputation as a bluffer and you can't stand being caught ignorant too often. Make it a practice to refresh your memory as often as necessary. Keep up to date.

13. Government texts and material available.—You should have an up-to-date copy of FM 21–6. It gives a complete list of Field Service Regulations, Field Manuals, Technical Manuals, Training Films, Film Strips, etc., which are available to help you in your work. This list is frequently revised; be sure you have the latest copy.

14. Technical library.—Wherever a course in driver training is being conducted, there should be a well-selected technical library containing privately published books as well as Government publications.

15. Lectures.—*a.* It will be necessary to give short lectures at times, but keep the lectures at a minimum. Don't make speeches.

b. When in an effort to be very accurate, you make an exact quotation, do it naturally. Take your time and talk to the class as you would normally talk to a friend, but using the words of the book or passage you desire to quote.

c. Practice reading aloud until you can "talk" the words of the text, but avoid reading any more than is absolutely necessary. If there is anything which will put a class to sleep more quickly than a long speech, it is reading to them.

d. Familiar, everyday words will be understood by all your students. Long and technical words may go over the students' heads, and because they will not like to admit they do not understand the words, they will not get the meaning of what you are saying. Then you will begin to wonder why you are not putting over your subject. So, use everyday words.

e. You can put over an idea in language that makes it clear to the student without attempting to give long definitions which are technically correct in every detail. Explain clearly and correctly, but avoid long technical definitions.

16. Questions.—You can make your teaching much more interesting and make much more lasting impressions by using questions to bring out various points. This does not mean just asking questions to test the student's knowledge. In fact that type of questioning is perhaps the least useful.

a. Questions to impart information.—When you make a statement to your class, the students may or may not understand it. But if you ask a good question and lead the class to a correct answer, each student must think in order to reply. Thinking impresses facts on the students' minds. Such questioning starts profitable discussions and sustains interest in the subject.

b. Progress test questions.—Another important type of question is that which tests not the students' knowledge, but your own success in putting over the subject.

c. Individual questions.—By asking individuals certain questions on what you have covered, or by asking them to explain the subject in their own words, you can tell whether or not you are putting over the subject. This type of question also enables you to know what to do next. If the students answer well, you know that you have successfully presented the subject. It's a green light and you can go on to something else. If they answer poorly, you know that you have not yet made it clear. It's a red light and further instruction is necessary.

17. Stories.—Stories, if well told, are helpful. Avoid stories which may offend the religious, moral, racial, political, or other feelings of any member of your class.

18. Blackboard.—*a.* Proper use of the blackboard is a form of visualization which can do much to help you fix facts in the student's mind. But it is necessary that it be properly used, or it will lose much of its effectiveness. Keep talking while you are working on the blackboard, explaining what you are doing. Turn your back to the class as little as possible. Most things can be put on the blackboard without turning entirely away from the class.

b. Erase things which are no longer needed before starting something new. The main value of the blackboard is visualization; leaving unnecessary material on it detracts from the new picture.

c. When possible, it is well to build up a picture as your lesson progresses, so that the students can visualize each part or step in its proper relation to other parts. You will note that this method has been used in many of the guides; for example, the "Power Train." It is suggested that you study and practice this form of blackboard work. You will find it helpful.

d. Take your time when writing on the blackboard. Be sure that you write and draw large enough to permit all to see. Use colored chalk to distinguish one part of a diagram from another, but be sure to use only colors which can be easily seen.

e. Be sure that you label all diagrams and make them as neat and simple as possible without being vague.

19. Moving pictures.—Moving pictures are valuable aids. They cannot replace other methods of instruction, but they may be used to advantage in introducing a subject, in presenting aspects which could not otherwise be shown, and in summarizing the basic content of instruction. A number of official films are listed in this guide.

20. Film strips.—Film strips are exceptionally good aids to teaching as the picture can remain on the screen while the subject is explained or discussed to such extent as may be desirable.

21. Charts.—Charts and diagrams prepared prior to the session are helpful in visualization. Some are suggested in the procedure guides. Be sure the charts are large enough and so placed that all can see clearly. Keep charts covered except when in use, so they will not distract attention.

22. Cutaway units.—When available, cutaway units are excellent to show just what is inside and how things work.

23. Real units.—Real units and tools may be used to advantage in classroom as well as in shop work.

24. Time of classroom sessions; recesses.—Since there is great difference in the scope and difficulties of the various subjects covered, there is also a great difference in the time needed to cover a subject. Furthermore, the amount of profitable discussion will vary with various groups. Avoid discussions that are unimportant, irrelevant, or too long. Don't waste time. When there is not time to cover a subject in a single session, split it into two or more sessions, selecting an appropriate place at which to stop. Keep single sessions of classroom work down to not more than 50 minutes, with a 10-minute recess in each hour.

25. Demonstrations and practical work.—Theoretical work in the classroom is necessary to pave the way for more practical work, but men learn best and remember longest that which they actually do. Therefore, keep following classroom work with demonstrations and actual practice and do it before the theoretical lessons have grown cold. A short period of demonstration, with brief explanations, can often take the place of thousands of words of explanation. The greater part of students' time should be spent in actually doing the jobs.

26. Practical driving.—The ideal situation when men are first permitted to drive would be to provide a vehicle for each student and to have a trained assistant instructor in the cab with each student driver. When that is not practicable, student drivers can alternate in the use of vehicles. Since much practice driving is done slowly, assistant instructors standing on the ground can direct and correct groups of students driving the vehicles on the driving course.

27. Criticism of practical work.—After students have done practical work, one or two faults in the work of quite a number of men will be noticed. Time can be saved by assembling the class and explaining such matters so that all can hear and understand.

28. Attitude toward students.—Show interest in the students. At the earliest convenient moment, try to have a short private talk with each man and show him that everything will be done to help him in any practicable way. Never humiliate a student by ridicule, or unnecessary public rebuke. Any statement a student may make shows he is probably in earnest, trying his best. Correct him courteously with due respect for his effort.

29. Individual attention.—*a.* In every class there will be some men who, because of superior ability or otherwise, are inclined to monopolize the discussion. That makes some of the less forward men feel neglected. They may lose interest. Avoid this by directing questions from time to time to every member of your class. Make each feel that he is getting individual attention.

b. It has been said that the sweetest words to any man are those of his own name. Your students will be pleased and will like you better if you call on them by name. If you have trouble in remembering names, you can have students sit in the same seats while you keep before you a seating diagram containing their names until you have learned them.

c. When a student does a job that is really good—something you know he is proud of—be smart enough to recognize the fact and polite enough to mention it. Mere flattery—praise of that which is poor—is worse than useless, but well-deserved recognition of anything that is good makes the student feel better and makes him like you. Don't overdo your praise.

d. Those students who show a genuine interest in learning more than is necessary for satisfactory completion of the course should be encouraged in their interest by as much extra guidance as possible from the instructor, outside of regular classroom or shop work.

30. Control.—Remember that you are in charge of the class. Keep both the class and yourself under control, and do not get off the subject.

An occasional short diversion may be helpful, but get back quickly to the main line of thought. Whether it be in the classroom or on the driving course, keep in charge and keep order. Exercise discipline quietly, but firmly. If you have trouble with discipline, consult a more experienced instructor or a commissioned officer.

31. Comfort of class.—The comfort of students is of utmost importance. It aids in gaining and holding interest. If students are uncomfortable, their minds will be on the cause of discomfort rather than on what is being said. Conditions will be limited, however, by regulations and facilities. Some of the things to consider include those mentioned in paragraphs 32 to 35.

32. Ventilation.—Be sure that the classroom is well ventilated. Lack of ventilation causes students to get sleepy.

33. Desks or tables.—Desks or tables should be large enough to permit each student to spread out papers or books and still have room to write comfortably.

34. Light.—Be sure there is good light for each student and good light on the blackboard.

35. Smoking.—Subject to local regulations and orders, men should be permitted to smoke during class sessions held outdoors. Give a short break if indoors. A man craving a smoke will not be an attentive listener.

36. General suggestions on preparations by the instructor.—The following suggestions concern preparations essential to effective teaching:

a. Be prepared—know the subject—be enthusiastic about it.

b. Have clearly in mind the objective for each presentation, and plan to stick to it.

c. Limit the number of ideas to be presented or skills to be taught at any one session. The human mind can't grasp too much at one time, so divide each unit on this basis as well as on the basis of available time, equipment, and facilities.

d. Plan to get maximum student participation.

e. Arrange in advance to have all necessary materials and equipment in their proper places and ready for use before the class begins. Unless this is done, valuable time will be wasted and disciplinary problems may arise.

f. Sufficiently in advance of each period, get together with all assistant instructors and describe the procedure to be followed, pointing out what each assistant is to do.

g. Work out specific schedules as far ahead as local circumstances permit.

UNIT 1—INTRODUCTION TO COURSE

37. General.—*a. Objective.*—To impress upon student drivers the importance of motorized transport in modern warfare; to interest them in the course they are about to take; to provide them with a picture of the types of training they will receive.

b. Place.—Classroom.

c. Teaching aids.—Driver Training Films 11–551 (reel 1), 11–554 (reel 1), 11–557 (reel 1).

d. Personnel.—One instructor.

e. Note to instructor.—The following lecture is written out word for word. However, unless you are skilled in reading effectively to an audience, you will probably put your talk over better if you thoroughly familiarize yourself in advance with this lecture, and restate it to the class in your own words. In any event speak directly to the students, speak with punch, do not talk too rapidly, and speak distinctly and loudly enough to be understood by everyone. Finally, feel free to improve upon the content of this lecture. Throughout this course, use any ideas of your own that you believe will produce results.

38. Role of motor vehicles in modern warfare.—Get one idea firmly fixed in your minds at the very start of this course. *This is a war of movement. It is a war of machines.* Many people have the idea that the only machines fighting this war are tanks, airplanes and guns. Those people are all wrong. Tanks will not roll, airplanes will not fly, and guns will not fire unless they are supplied with oil, gasoline, and ammunition. The men at the front cannot eat unless food is transported to them. In this war, the striking power and the speed of movement of our Army will depend largely on the efficiency of our military motor transport system and its ability to get war materials to the places where they are needed and get them there on time. So this is what I want you to realize clearly from this moment on throughout your training course and throughout the duration of this war: *The Army's system of motorized transportation is the backbone of our whole military system.* The better our system of motorized transportation, the more effective will be our entire war effort, *so if you go through this course successfully, you will be assigned a job of vital importance to your army and your country.* During the Civil War, General Nathan Bedford Forrest of the Confederate Army explained his ability to win victories by the statement: "Just git thar fustest with the mostest men." General Forrest's rule is just as true today as it was then. The only difference is that General Forrest and his men traveled on horseback and lived

off the country, while today armies travel by motor vehicle and must be supplied from depots located far behind the fighting front.

a. The "taxicab army" of 1914.—The first great example of motor vehicles playing a decisive part in warfare occurred in World War I. In September, 1914, the Germans had reached the Marne River, and it looked as though nothing could stop them from breaking through and taking Paris. Then and there the war might have been lost by the Allies, but General Joffre commandeered all the motor vehicles in the Paris district and rushed enough reserves to the front to drive the Germans back. That was the famous "taxicab army" of 1914.

b. Verdun.—Then there was Verdun. The French railroads had been destroyed. The Germans were striking with everything they had. *In 10 hours, the French moved an entire army corps to the front with motor vehicles. You all know that the French held at Verdun.*

c. Cambrai; Chateau Thierry.—It was a 5,000 truck convoy in the fall of 1917 that enabled the French to rush 100,000 reinforcements to Cambrai, where the Germans had broken through the British lines. And at Chateau Thierry, the Germans were stopped because they got ahead of their lines of supply and because the French and Americans were able to rush fresh troops to the Marne.

d. Other examples.—On the whole, World War I produced few examples of motor vehicles playing decisive roles. For the most part, men traveled on foot, and 30 miles in 1 day was a good march. When generals wanted to shift troops and equipment to a new sector of the front, they had to allow weeks to complete the transfer. As a result of this slowness, the war bogged down into a military stalemate, with millions of men standing in trenches facing each other across a stretch of mud and barbed wire and blasted trees that came to be known as "No Man's Land." The stalemate might have gone on for years, with neither side able to win much ground, had not the manpower and supplies which the United States threw onto the scales upset the balance.

e. Today's armies are on wheels.—In the 20 years between the first and second World Wars, the number of motor vehicles in this country has multiplied five times. In 1918 there were six million automobiles and trucks in the United States; today there are thirty-two million. Similar development of motor vehicle transportation has taken place in all the countries fighting this war. *The world is on wheels. The world's armies are on wheels.* And the side that does the best job of keeping its motor vehicles rolling will win.

f. Motorized army helped smash Poland.—When the Germans smashed into Poland in the summer of 1939, they came in tanks, then

motorcycles, then trucks—column after column of trucks, thousands upon thousands. The Germans overran Poland in a month.

g. Motorized army helped smash Belgium and Holland.—In the spring of 1940 the same thing happened again. The Germans struck through Belgium and Holland. First came the tanks, then the motorcycles, then the thousands of trucks carrying fuel, ammunition, food, and all the other essentials of motorized warfare. In days—not months—the Germans reached the Channel Coast and drove the British into the sea at Dunkirk. In days more—not months—the Germans were in Paris. The French were knocked out of the war.

h. Russia.—In the summer of 1941 the same thing happened again. The Germans struck at Russia; in the first week the vanguard of their armies had advanced scores of miles, and again the second week. It looked bad. But finally the advance slowed down, first, because the Russians were fighting magnificently; second, because the Germans had to move thousands of tons of material greater and greater distances to supply those forces which were actually in contact with the Russians. The German tanks were just as efficient as they ever were; so were the German motorcycles, machine guns, artillery, and men. But the things necessary to keep the tanks, motorcycles, machine guns, artillery, and men fighting were not reaching the combat zone fast enough. Then the Russian winter came, and the German drive stalled in its tracks. One explanation is that the synthetic oil the Germans used to lubricate their motor vehicles broke down in the extreme cold. Whether or not this is true, the Germans themselves explained their failure to take Moscow in the fall of 1941, as due to the long lines of supply they had to maintain, the bad Russian roads, and the terrific cold. Whatever the cause, the fact is that the wheels of the German Army did not keep rolling the way they did in Poland, Belgium, Holland, and France. The result was that the Germans were stopped, and the Russians gained time to prepare a counterattack.

i. Key to swift Army movement.—This war is a war of great distances and swift movement. It is possible to move whole divisions of men and everything men need 500 miles or more in a single day. *The key to swift Army movement is the Army truck.*

j. Motor vehicle supremacy of the United States.—The United States Army trucks are the best in the world. They should be, because this country builds the best automobiles in the world and is the most highly motorized nation on earth. There are more motor vehicles in the United States than in the rest of the world combined.

39. Training for effective military motor vehicle operation.—*No machine is better than the man who operates it, and this is*

just as true of a motortruck as it is of a pursuit plane or an antiaircraft gun. We can have the best Army trucks in the world, and we can have more of them than any other army in the world, and yet we can still fail to properly support our combat troops. In addition to good vehicles, we must have good men to operate those vehicles.

a. Selecting men for training.—You men are going to be trained to operate Army vehicles. The Army has selected each of you with great care, in order to make sure that you are the type of man who could become an efficient and dependable motor-vehicle operator. You have been tested for general physical fitness, eyesight, intelligence, and other qualifications. You have passed these tests, and the Army feels that you are a group of men who can successfully complete this training course and who can be trusted afterward with very valuable machines.

b. The course.—(1) The things that you will learn in this course will fall into two general categories:

(*a*) How to take care of the vehicle that you will have to drive.

(*b*) How to drive that vehicle under all conditions of weather, on all sorts of roads, and in places where there are no roads (through woods, over streams, across shell holes, etc.).

(2) Notice that the care of the vehicle comes first. That is because you must know something about the vehicle in order to be able to operate it most effectively, and also because you are the person responsible for its day-to-day care. There is no point in your being a first-rate driver if the vehicle you are to drive is in such poor shape that it will not run. You will be required to see that it is kept in the best possible condition. You will be taught all the things that you should know and do to keep your vehicle running smoothly.

c. Not a course on automotive mechanics.—The Army does not expect you to be able to do the things an experienced mechanic can do. You will not be asked to take an engine apart and put it together again. If your vehicle breaks down, repair crews will put in replacement parts; and if the trouble is something that calls for shop work, the vehicle will be taken to the shop and fixed. But remember—you will be the man closest to your vehicle, and you will be the man who will make most of the inspections and adjustments that will prevent serious trouble.

d. Factors involved in operating an Army vehicle.—So far as actual driving is concerned, there is a great deal of difference between operating a civilian motor vehicle and operating a military motor vehicle. The shifting of gears in many military motor vehicles is more difficult and involved. The Army driver has to operate his

vehicle under extreme conditions—cross-country, in mud and sand, across streams, up and down steep grades that no civilian vehicle could negotiate. Because Army motor vehicles must be kept moving under such conditions, they are far more powerful than civilian trucks. Many Army vehicles have powered wheels on both front and rear axles. They are equipped with various traction devices for crossing bogs and muddy terrain. They are also equipped with winches for rescuing stuck or overturned vehicles.

e. Rules and regulations.—In addition to receiving instruction in driving under both ordinary and difficult conditions, you will be taught the rules of the road. The Army is going to make sure that you know the traffic regulations and that you observe them. It cannot afford to lose motor vehicles, cargo, or men because drivers operate their vehicles in violation of the traffic regulations, such as those governing speed and right-of-way. Of the 40,000 fatal traffic accidents in the United States last year, a large majority involved violation of traffic regulations or bad driving practices.

f. How course is arranged.—This course is so arranged that some instruction will be given in the classroom, some in the shop, and most of it on driving courses, streets, highways, and open country. The chief emphasis will be placed on learning by doing. How well you succeed will be revealed by written and practical examinations to be given from time to time.

g. Importance of teamwork.—You are all going through the same training; and the same type of training is being given throughout the Army. The reason for this is that effective military motor transportation depends on teamwork—teamwork within each company and between organizations. The rules of the game and the techniques must be the same for all vehicle operators on our side, for the same reason that every man on a football team has to know and follow the same signals. Otherwise victory is going to be much farther away. So play ball with your teammates—follow the rules, and do your best to learn the techniques that we have worked out for our side. And remember—teamwork should start right now. If you cooperate, you will become first-rate military vehicle operators in the shortest possible time and then more men can be trained with a minimum of delay. Our Army and our country depend on vast and effective military motor transportation. That is going to be your job. You will now be shown some motion picture films on the training of Army drivers. These should give you an idea of what lies ahead of you in this course.

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UNIT 2—PHYSICAL AND MENTAL QUALITIES AFFECTING OPERATION OF MOTOR VEHICLES

40. General.—*a. Objective.*—To develop in student drivers an understanding of—

(1) Mental and physical qualities which affect the operation of motor vehicles, and

(2) Means by which drivers with mental or physical handicaps can correct or compensate for such deficiencies.

b. Place.—Classroom.

c. Reference.—Section I.

d. Note to instructor.—The following lecture is written out word for word. However, unless you are skilled in reading effectively to an audience, your lecture will be more readily understood if you thoroughly familiarize yourself in advance with it, and restate it to the class in your own words. In any event, do not talk too rapidly, speak directly and distinctly to the students, and loudly enough to be understood by everyone. As you discuss the various points, ask students to describe any relevant experiences they have had or encountered. If possible, have driver testing devices on hand to refer to as you review the various tests taken by the men.

41. Accidents and drivers' physical and mental condition.—*a.* The physical and mental condition of drivers largely determines whether or not they are likely to become involved in accidents. It is reported that in nine out of every ten motor-vehicle accidents, fatal and nonfatal, the driver, not the machine, was at fault. Ten percent of all fatal traffic accidents are caused by drivers who have some physical defect. More than 50 percent are caused by drivers violating traffic regulations. This is only another way of saying that in some way or other the drivers causing those accidents are not mentally fit, or mentally on the job.

b. A report of the British Government stated that every day British Army drivers damage 300 Army trucks in accidents. The investigation showed that most of these accidents were the fault of the drivers.

c. In a recent year more than 40,000 persons in the United States were killed in traffic accidents. Such an accident record is bad enough in peacetime, but it is absolutely inexcusable in wartime, particularly if the accidents are caused by the drivers of military motor vehicles.

d. The Army has required you men to pass certain physical and mental fitness tests before admitting you into the Army and enrolling you in this Military Motor Vehicle Operator's Course. In much of your driving you will meet civilian drivers who were not required to go through such rigorous tests to obtain their licenses. Do not

take their physical and mental fitness for granted. Consider that they may have various defects, and drive accordingly. Furthermore, there are some conditions that you should know about for which you were not tested. Finally, some of the traits in which you are now normal may change undesirably—your eyesight, for example. Therefore, it is necessary that you have a clear knowledge of the physical and mental qualities which affect driving.

42. Physical fitness.—*a.* The first of these is good health. No person suffering from a disease which is likely to result in sudden collapse should drive a motor vehicle; certainly no person who has serious heart trouble should drive.

b. All drivers should use extra care when they are not feeling physically fit, under either of these two circumstances:

(1) When extremely tired, sleepy, or in a state of high nervous tension.

(2) When suffering from any minor ailment which distracts attention or reduces efficiency. (The ailment might even be no more than a common cold, headache, or toothache.)

c. No person should operate a motor vehicle when under the influence of liquor or drugs.

43. Vision.—Of the five senses, eyesight alone gives us about 80 percent of all our impressions. The importance of good eyesight to safe motor vehicle operation is so obvious that a man with very poor eyesight would be foolish to attempt to drive a motor vehicle.

a. You have already been given a series of tests, and results show that your eyesight should not interfere with your becoming competent drivers. These included tests for clearness of vision and degree of side vision.

b. The test for clearness of vision, as you recall, was a simple one with which many of you were familiar before you came into the Army. In this test you were asked to read, at a distance of 20 feet, letters of various sizes printed on a chart. There were big letters at the top, and as you read down the chart the letters were smaller. Very few people can read the letters on the bottom line of a chart like this. But if you can read most of the lines, with or without glasses, you have satisfactorily clear vision for driving purposes.

c. The importance of clear vision is proved by a recent State Department study of motor vehicles. This study revealed that in a certain large city, 20 percent of all drivers involved in fatal accidents could not see as clearly as an average person. What is particularly significant is the fact that in every case the fatal accident was caused by the driver with poor eyes.

d. Army drivers who are required to wear glasses should never drive their vehicles without glasses except in a very serious emergency, and then they should drive with unusual caution and concentration.

44. Side vision.—Another vision test which you were given was for side vision, or the ability to notice objects and movement at a considerable distance on your right or left side when you are looking straight ahead. Side vision, or "tunnel" vision as it is commonly called, is really the ability to see out of the corner of your eye.

a. Importance of side vision.—You can realize how important side vision is to the driver by considering the following circumstances:

(1) A motor vehicle operator is driving down the road approaching an intersection. Another vehicle is approaching the intersection from either the right or left at such a speed that both vehicles will reach the intersection at the same time. If the driver of the first vehicle has such poor side vision that he is unable to see the second vehicle, there is likely to be an accident, unless the driver of this second vehicle is able to stop in time.

(2) A driver is about to shift his vehicle over toward the middle of the road in order to make a left turn. Another vehicle is coming up from behind and is swinging out to pass. If the driver of the first vehicle has poor side vision, he may not notice the approach of the second vehicle, and there may be an accident.

(3) A vehicle is being slowly driven down a street lined with parked cars. A few feet ahead an absent-minded pedestrian steps off the curb and walks toward the oncoming vehicle. Unless the driver has good side vision he may not see the pedestrian and there may be an accident.

b. Compensating for defective side vision.—The driver who has poor side vision can compensate for this deficiency to some extent by turning his head slightly from side to side when driving so as to get a wide picture of the situation ahead. If the defect is limited to only one eye, he can keep his head turned slightly toward the abnormal or "blind" side. Obviously all drivers with this deficiency must take special precautions at intersections, when passing driveways, and when approaching all other traffic, both vehicular and pedestrian. They also have to be especially on the alert for cars approaching and passing from the rear. This can be done by listening attentively; by using a rear-view mirror; and by keeping in one lane as much as possible. It is important to bear in mind that while you may not have poor side vision, you must always be on the alert against the driving faults of others who may have this deficiency. You can never be

sure, when you see a driver or a pedestrian approaching from either the right or left, whether he has seen your vehicle. If he has poor side vision, he may not see you and he may not stop.

45. Judging distance.—*a.* Many people are unable to judge the distance of objects accurately. A person who cannot judge distances well has poor depth perception. Poor depth perception is the cause of a great many motor-vehicle accidents.

b. A specific example is the actual case of a certain driver who had nine automobile accidents in a single year. All these accidents were caused by his ramming into the car ahead as it slowed down or stopped. These accidents were due to his not being able to judge correctly the distance of the car ahead, which each time was closer than he supposed. When tested for depth perception, he said that he had never known that his eyesight was in any way defective.

c. In the test given to prospective airplane pilots, the prospect is required to aline two rods, 20 feet away, by pulling on strings attached to the rods. The person taking the test must be able to line up the rods within 1 inch of each other.

d. When you are driving in traffic you will meet many drivers who have poor depth perception. You can protect those drivers as well as yourself and your vehicle by always giving the proper hand signals before slowing down or stopping, and by being on the alert to pull off the road if the driver of a vehicle attempting to pass from either direction has misjudged his distance.

46. Night vision.—*a.* You have also been tested for your ability to see in the dark. Obviously military motor-transport operators must have exceptional ability to see in the dark because much military driving is done by the Army at night under blackout conditions with no normal driving lights shown by vehicles.

b. Even on the darkest nights it is possible for a person with good vision to distinguish the outlines of trees, buildings, and other objects.

c. However, some people are unable fully to adapt their eyes to the dark even after a long period in darkness. This condition is known as night blindness, and you were tested for it before you were enrolled in this course.

d. It will interest you to know that scientific tests have shown that night blindness in many cases can be corrected by vitamin A. Food such as carrots, butter, eggs, and spinach are rich in vitamin A and are very beneficial in curing cases of night blindness.

47. Glare blindness.—*a. General.*—(1) You have all had the experience of walking from a sunlit street into a motion-picture theater and finding that you could see nothing for a short period of time.

(2) Similarly if you have driven a civilian motor vehicle, you may have had the experience of being partially blinded by the headlights of oncoming vehicles. It takes time for your eyes to recover from the glare after the vehicle has passed.

(3) Even a person with perfect eyesight finds driving at night more difficult than driving in the daytime. Persons who are extremely sensitive to glare are likely to become involved in accidents unless they drive with great caution at night. It is interesting to note in this connection, that there are three times as many traffic accidents per mile traveled at night as there are in the daytime.

(4) Some drivers will experience a considerably longer-than-normal period of partial blindness from glaring lights. Normally the major degree of recovery will take place within 10 seconds. How far will a car going 30 miles an hour travel during 10 seconds?

b. Precautions against glare blindness.—Here are several ways to avoid being blinded by headlight glare when driving at night:

(1) Keep to the extreme right-hand side of the road when vehicles are approaching from the opposite direction.

(2) Slow down when bright lights are approaching and do not speed up after they have passed until your eyes have readjusted themselves to the darkness.

(3) Do not look directly at the headlights of oncoming vehicles.

(4) Steer by watching either the center line or the right-hand edge of the road, but watch out of the corner of your eye to make sure of the position of the oncoming car.

48. Color-blindness.—*a.* At one time or another, some of you may have been asked to separate red, green, and yellow objects or to read numbers on charts containing many small circles of different colors. Obviously you were asked to do this because in traffic signal lights red means STOP and green means GO.

b. Fortunately a person who is red-green color-blind can usually distinguish between red and green colors, even though these colors do not seem the same to him as to us. They may appear to him to be different shades of gray. Consequently an individual who is red-green color-blind is not greatly handicapped in his driving, particularly if he is aware of his condition, makes a point to watch carefully the actions of other motor vehicle operators, and learns the relative position of red and green traffic lights in localities where he generally does his driving. Finally, modern red and green signal lights are of hues so selected as to aid red-green color deficient persons in distinguishing between them.

49. Using good eyesight effectively.—*a.* You may have better-than-average eyesight. Nevertheless, the fact that your eyesight is good is no proof that you will be a safe driver. Merely possessing good eyesight is not enough—you must also use it properly.

b. You must pay careful attention to the entire scene ahead and to all the details of that scene which in any way affect your driving. You must be able to recognize hazardous situations at the earliest possible moment and know what to do to avoid such situations.

50. Reaction time and control.—You must be able to act quickly and correctly in an emergency. There is a considerable difference among individuals in the speed with which they think and act in an emergency. In addition to having fast reaction time you must also react correctly. In a tight situation it does no good to slam on the brakes and perhaps skid the vehicle into a ditch when by stepping on the accelerator you would have avoided the danger.

a. Importance of quick, correct reactions.—The importance of quick and correct reactions is shown by the following comparisons: Suppose you have a reaction time which is normal—about ¾ second in a situation where you must make an immediate choice. Assume that you are driving at 30 miles an hour along a residential street lined with parked cars. Ninety feet ahead a child darts out in front of your vehicle and stops, paralyzed with fright. You slam on the brakes, and your vehicle comes to a halt 7 feet from the child. If you had simply removed your foot from the accelerator very quickly and honked your horn, the child probably would have been struck by your car. The accident might have happened too, if you had tried to steer clear of the child instead of stopping. But suppose now that your reaction time is slower than normal—about ¼-second slow. In that ¼-second your vehicle would travel 11 additional feet before you began to apply your brakes. All other things being equal, your vehicle would strike the child and travel 4 feet beyond before coming to a halt.

b. Reaction time distance.—Bear in mind that even if your reaction time is normal or better than normal, your vehicle will always travel a certain distance before you can make any movement whatever to stop it or change its direction in an emergency. In the case of a person with ⅔ second reaction time, which is not far from normal, the distance in feet that the vehicle will travel before the brakes are applied is about equal to the speed of the vehicle in miles per hour; for example, if you are driving at 10 miles an hour and a child runs out in front of your vehicle, you will travel 10 feet before you can react to the scene by lifting your foot from the accelerator and jamming it down on the brake pedal. At 20 miles per hour this distance will be

approximately 20 feet; at 30 miles per hour, 30 feet; at 50 miles per hour, 50 feet. Remember that these distances are only the number of feet that the vehicle will travel before you can begin to stop it or change its direction. This is the "reaction time" distance.

c. Total stopping distance.—To get the total distance you would need to stop a vehicle, you would have to add to your reaction-time distance the distance it would take the brakes to stop the vehicle. At 60 miles per hour, the combined reaction-time and braking distance, in the case of an average civilian motor vehicle (with good brakes driven by a person with good reaction time), is more than 250 feet. Drivers with slow reaction time can compensate to some extent for this deficiency by taking special care to keep out of situations which call for snap judgment. They can do this by paying careful attention when driving in traffic; when driving on unfamiliar roads; when in the vicinity of schools, playgrounds, or other thickly populated districts; and when other vehicles are approaching from the opposite direction. *They can cut down on speed!* Even though you may have good reaction time, you must always guard against putting your vehicle in positions where you will compel other drivers to think and act quickly. Remember that if the other driver's reaction time is slow, he may plow into you before he has time to move a finger or a foot to avoid an accident.

51. Fatigue.—There will be times when you will be very tired, yet have to drive your vehicle. Military operations are not carried out on a 40-hour or a 5-day week basis. If you have to drive long hours, you should bear in mind that fatigue is a serious cause of motor vehicle accidents and you should do all you can to protect yourself and your vehicle.

a. Effects.—Extreme fatigue affects drivers in two ways:

(1) It causes drowsiness which may at any moment turn into total unconsciousness in spite of the driver's best efforts to stay awake.

(2) The very tired driver may believe that he is capable of driving safely, although as a matter of fact he may be incorrectly judging distances, speed, and driving conditions; he may be slow in his responses and may even be seeing things incorrectly. Shadows may look like persons walking along the road or like other vehicles, and trees may look like people.

b. How to offset fatigue.—When suffering from extreme fatigue it is wise for you to let the assistant driver drive or, if possible, to pull your vehicle off the road and sleep for a while until you are fit to

go on. There will be times when you cannot do this because you will have to get to a certain destination at a certain time, or perhaps because you will be operating in a convoy or motor march in which vehicles must drive at a certain speed and keep a certain distance apart. In such cases you may take stimulants such as strong coffee or tea; you should keep the windows of your vehicle open and breathe deeply and, if possible, stop your vehicle at frequent intervals for a few minutes, and get out and exercise. The best way of preventing fatigue is to get plenty of sleep at night.

52. Mental and emotional attitudes toward driving.—The majority of motor-vehicle accidents are not caused by drivers with physical defects. They are caused by drivers who have something wrong with their ideas or attitudes. This is shown by the fact that the main cause of all accidents is violation of traffic rules and sound driving practices, excessive speeding, passing at the wrong time, violating the right-of-way, driving on the wrong side of the road, etc.

a. The egoist.—A driver can have the best eyesight and reaction time in the world and be able to operate his vehicle as skillfully as any man, but if he has the idea that he is the only important person on the highway, sooner or later he is going to cause an accident. This sort of driver is an egoist. He is mentally sick. He looks at his vehicle as a means of expressing himself and his importance and imposing his will upon others. He speeds whenever he is sure that he can get away with it and ignores traffic lights and stop signs. He likes to pass the vehicle ahead, when there is not enough room to do so without cutting in, and likes to crowd other drivers into the ditch. He seldom signals his intentions to other drivers. His motto is "let others look out for themselves." He blows his horn at every opportunity. If he gets involved in an accident his most likely defense is, "I blew my horn but the other fellow didn't get out of my way."

In civilian life that sort of person is disliked by everybody with whom he comes in contact and sooner or later he is stepped on forcefully. In military life you cannot operate your vehicle as though you are the only driver on the road. You must abide by the rules and regulations at all times whether you want to or not. The Army hopes that you will want to do this of your own free will and without compulsion.

b. "Show-off" drivers.—Here are some of the stunts of "show-off" drivers who wrongfully think they are clever and smart. If you feel the impulse to indulge in any of them, do not obey it.

(1) Driving as fast as they dare, particularly if they have passengers who are easily impressed.

(2) Speeding right up to a red light and then jamming on the brakes; rubber is too important in the war to be wasted in this way.

(3) Weaving in and out of heavy traffic while steering with the fingertips of only one hand.

Although it may sometimes be necessary to operate Army vehicles at extreme speeds and even dangerously, military motor-vehicle operators, their vehicles and cargo are too valuable to be lost or damaged by show-off stunts. Too many people have the idea that war calls for recklessness. That idea is wrong.

c. Temperamental drivers.—Good drivers cannot afford to let themselves get temperamental. Temperamental is a word used to explain the fits of temper, sulkiness, obstinacy, and bad humor which emotionally uncontrolled people exercise when things aren't going well. The temperamental or emotional driver honks his horn incessantly, weaves in and out of congested traffic, tries to get the jump on other drivers, bawls out other drivers whether or not they are in the wrong, and works himself into a nervous frenzy if for any reason he is delayed. All these acts are dangerous and foolhardy. A good driver must learn to control himself temperamentally. Driving a military motor vehicle is too serious a business to be entrusted to people who cannot control their emotions. If you have good attitudes and good control over your emotions in addition to good physical equipment and good brains, you will become good drivers.

53. Cooperation in driving.—*a.* If your attitude toward other people and toward regulations is one of cooperation rather than one of absolute disregard for others, you will be a better driver. With a cooperative outlook you will get along better in the Army just as you would in civilian life, and you will not let your buddies down by failing to "deliver the goods" on time because of an accident or unnecessary delay.

b. If you have the right attitude toward driving, the best way for you to put that attitude into effect is by mastering the operation of your vehicle and by obeying all traffic rules and regulations. It is not enough to have the right attitude—you must put it into effect. Good intentions and good attitudes are fine, but carry them out in action. For the final test of whether you truly hold the right attitude is determined by whether you actually carry it out in practice.

54. Accident repeaters.—In a study of many thousands of drivers, 4 percent were found to be responsible for 36 percent of the total number of accidents. Drivers who have frequent accidents usually have one or more of the vision defects discussed, they have very slow reaction time, or they are not mentally and emotionally competent to

drive their vehicles, or they may suffer from various combinations of these faults. Drivers who get involved in accident after accident are called "accident prone" or "accident repeaters."

55. Developing good habits.—Here are a few pointers which will help you in learning to become good drivers:

a. Pay careful attention. It will save you time later.

b. If you don't understand some point, ask about it.

c. Work hard to master every step in your instruction so that you will not become the "bottleneck" of the class.

d. Once you know the right way to do a thing, repeat it over and over. After a while it will become automatic and you will not have to think about it.

e. It is just as easy to learn to do a thing right as it is to learn to do it wrong. If you learn to do it wrong, it is a much tougher job to learn to do it right.

UNIT 3—FIRST ECHELON PREVENTIVE MAINTENANCE

INTRODUCTORY NOTES FOR INSTRUCTORS

It is suggested that you read this entire unit before undertaking any instruction. By doing so, you will get a complete picture of the manner in which the whole subject of preventive maintenance is presented. Understanding of the complete picture is necessary for efficient handling of any one part.

As you read through the unit, you will note that the instructional procedure consists of lectures, discussions, demonstrations, and practice. Demonstration and practice constitute the larger part of the instructional procedure. However, the lecture technique prevails in Unit 3B (pars. 69 to 73, incl.). If local circumstances should require that lecturing be minimized and that attention be given almost exclusively to learning by doing (that is, to actually practice following demonstration), this substitute procedure is recommended:

Use Unit 3B only in connection with Unit 3D (pars. 89 to 103, incl.) in such a way that nomenclature, location and function of vehicle parts are learned through actual demonstration and performance of the preventive maintenance schedules (servicing responsibilities). Thus, in demonstration and performance of the after-operation check (Preventive Maintenance Schedule No. 2) reference would be made to the location and function of the radiator when the schedule item dealing with the radiator (item 2–26) was reached.

Instruction of the men in this connection would proceed somewhat as follows:

"This is the radiator (point to it) the function of which is to help cool the motor-vehicle engine so as to prevent overheating and expansion of engine parts and consequent stopping of the engine. The water supply in the radiator makes this possible. After operation of the vehicle, remove the radiator cap (demonstrate how this is done, indicating the importance of being careful of steam) and replenish water if it is low. A heavy layer of oil on water in the radiator may indicate leaking or cracked engine parts. Do not operate the vehicle in this condition."

Such demonstration and explanation should be followed by student participation in and practice of the servicing operation described in Unit 3D. It is expected that this procedure will save some time, although perhaps at the cost of limiting the students' understanding of total vehicle functioning.

A—PURPOSE AND FUNCTION OF PREVENTIVE MAINTENANCE AND ECHELON SYSTEM OF MAINTENANCE

56. General.—*a. Objective.*—To develop in student drivers—

(1) An understanding of the necessity for maintaining military motor vehicles in the best possible operating condition at all times.

(2) An understanding of the echelon system of maintenance and of driver responsibilities and limitations under the echelon system.

b. Place.—Classroom.

c. Materials.—Photographs or actual vehicle parts showing failures due to lack of preventive maintenance, blackboard, and chalk.

d. References.

TM 10–525, Echelon System of Maintenance.
TM 10–545, Motor Vehicle Inspections and Preventive Maintenance Servicing.
Motor Transport School Text No. 16, Military Motor Transportation.
TM 10–460, Driver's Manual.
Manufacturer's Maintenance Manuals and Parts Lists.

57. Dependence of driver on condition of vehicle.—Assemble student drivers in classroom with blackboard on which has been written the following maxim:

"For want of a nail the shoe was lost,
For want of a shoe the horse was lost,
For want of a horse the man was lost,
And all for want of a horseshoe nail."

Then briefly point out the following:

The best driver in the world cannot "get his vehicle there" if it will not run. Therefore, the first essential to the operation of a military motor vehicle is that the vehicle be in condition to operate at all times and at a moment's notice, and that it be in such mechanical condition that it will get through to its destination on time and with its cargo intact.

Consequently, the Army's first step in training men to become proficient drivers will be not to instruct them in the actual operation of vehicles, but to instruct them in how to keep vehicles in such condition that they are always ready to operate.

58. Differences between civilian and military drivers.—*a.* The average civilian driver knows very little about keeping his vehicle in good condition. This is proved by the fact that over a million of the automobiles junked in this country each year, prior to the outbreak of war, were not junked because of old age, but because neglect and abuse had worn them out prematurely.

b. In the event of a break-down, a civilian driver can usually have his vehicle towed or pushed to the nearest service station and perhaps eat a hot dog while repairs are being made. But the military motor vehicle driver can do only one of two things: when operating alone, either repair the break-down on the spot with whatever tools he has or summon help from military sources.

c. When a military motor vehicle breaks down, munitions, food, or other supplies may not reach their destination on time, with the result that many lives may be lost; additional work will be thrown upon already overworked repair crews; the vehicle may be left far behind other vehicles in the organization and, in certain cases, the vehicle and cargo may be permanently lost.

59. Causes of motor vehicle break-downs.—Point out that one of the chief causes of motor vehicle break-downs is friction between moving metal parts.

a. Failure to lubricate properly.—Ask the question: "How may friction be reduced so as to avoid damage?" (By proper and regular oiling and greasing.) Pass photographs around the class or exhibit actual examples of broken spring-shackle pins, broken bearings, drag links (see fig. 5), etc., which resulted because of insufficient lubrication, and explain that failure of all of these parts was due to somebody's neglect to lubricate properly. Do not attempt to describe any parts at this time, but emphasize that in every case the vehicle could not be operated until the broken parts were replaced with new parts. While photo-

graphs or models are being examined, change the maxim on the blackboard to read:

"For want of some oil the bearing was lost,
For want of the bearing the truck was lost,
For want of the truck the driver was lost,
And all for the want of a little oil."

b. Failure to tighten connections.—Point out that another major cause of motor vehicle break-down is due to failure to tighten connections of various sorts with the result that parts gradually work loose from vibration and are lost or broken. Explain that such connections are usually nuts, bolts, and screws. (See fig. 6.)

c. Failure to adjust parts.—Point out that in any complicated machine, particularly in a motor vehicle, there are many parts which must be kept properly adjusted or they will fail to function properly.

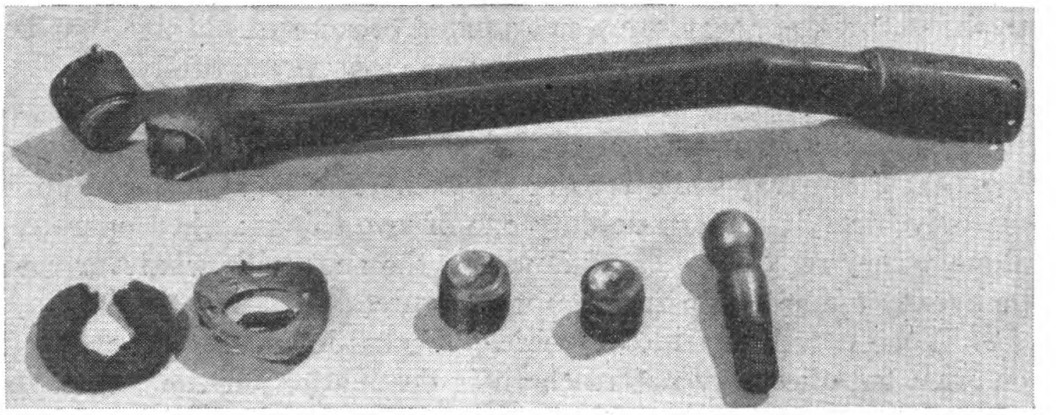


FIGURE 5.—Broken drag link plus a badly worn steering knuckle ball. (This is the result of lack of lubrication and maladjustment.)

Mention the distributor points, spark plugs, carburetor, voltage regulator, fan belt, etc., and that these are only a few of the items which must be kept properly adjusted if the vehicle is to continue to run dependably. Mention briefly that later in the course you will explain, and have student drivers practice the making of, all adjustments which they are required to perform.

d. Conditions resulting in fires.—Point out that many vehicles are destroyed by fire because leaks in the gasoline tank, fuel line, and engine were not repaired, or because sparks from frayed, broken, or short-circuited wires ignited the fuel. Add that other causes of vehicles catching fire are holes in exhaust pipes through which burning gases can come in contact with oil, wood, or fuel tanks or fuel lines; that a vehicle may sometimes catch fire when the engine is extremely overheated, and that such severe overheating may be caused by failure to keep the engine properly lubricated and the cooling system full of

water and working properly. Overheating often causes engine parts to melt or stick together ("freezing" or "seizing").

60. Causes of accidents.—Explain that some types of vehicle failure are so serious and may occur so abruptly that they cause many accidents. Give as an example a broken hydraulic brake-fluid line or leaking wheel-brake cylinder resulting in sudden brake failure. Emphasize that the only way to avoid accidents due to these failures is to frequently inspect a vehicle and correct or report defective conditions as soon as they are detected.

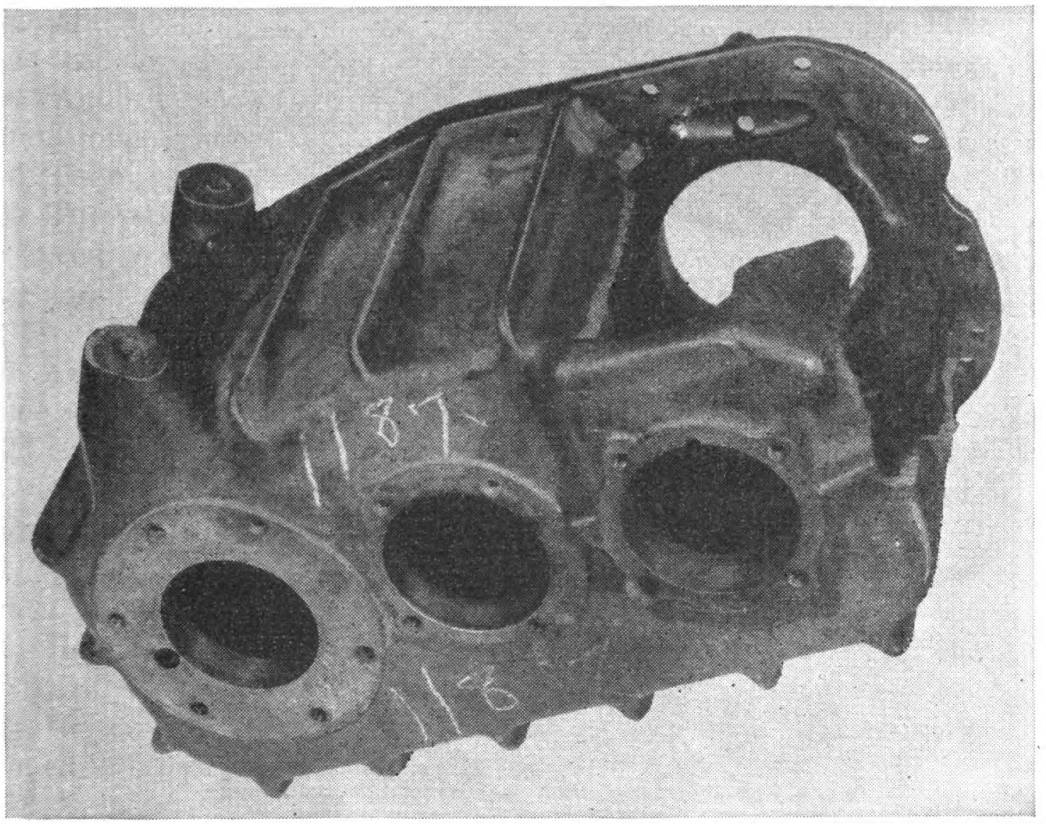


FIGURE 6.—Broken transfer case. (This has been caused by loose mounting bolts. A simple preventive maintenance check would have avoided this serious damage.)

a. Tire blow-outs.—Mention the following conditions which may lead to tire failure or blow-out:

(1) Stones and nails which were not removed from tires or which were wedged between dual tires.

(2) Bruises on tires caused by drivers scraping sidewalls along curbs.

(3) Treads worn smooth with fabric showing through.

(4) Tires with treads worn unevenly because wheels were not in proper alinement or balance, or because tires of different sizes were used on opposite wheels on the same axle.

(5) Underinflated tires becoming hot at high speeds and overinflated tires expanding beyond strength of tires. (See fig. 7.) Explain that when a tire blows out, a vehicle tends to swerve off the road, or perhaps into the path of oncoming vehicles, and that it takes an extremely alert, well-trained driver to hold a vehicle on the road in the event of a blow-out.

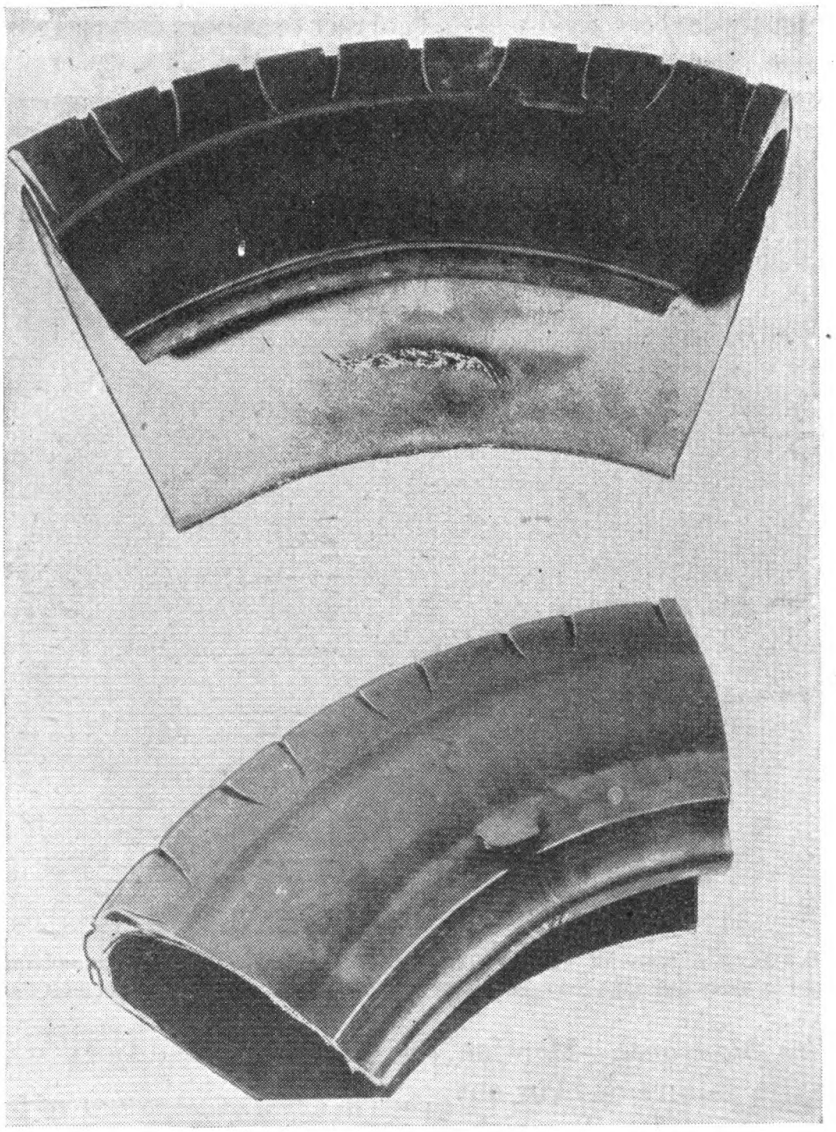


FIGURE 7.—Rim bruises. (Outside and inside rim bruises all caused by underinflation. Daily check on tires would have prevented this damage.)

b. Steering failures.—Point out that a failure of any part of the steering assembly while the vehicle is being operated may result in a driver being unable to control the direction of his vehicle, making an accident possible; that steering failures may occur in any of a num-

ber of important parts of the steering assembly. Emphasize that the steering assembly can be kept in safe condition without much difficulty by inspecting, lubricating, and tightening. (See fig. 5.)

61. Benefits of preventive maintenance.—*a.* Point out the following benefits which result when all the parts of a motor vehicle are kept in the best possible mechanical condition at all times:

(1) There will be more assurance that the vehicle will be able to get safely to its destination under extreme conditions of weather, terrain, load, etc.

(2) The vehicle will seldom be laid up for emergency repairs.

(3) The life of the vehicle and of its parts will be prolonged. This means that more of the nation's resources, such as automotive plants, metals, rubber, etc., can be diverted to the manufacture of airplanes, ammunition, and similar materials of war.

(4) There will be less physical and mental strain on the driver.

(5) The possibility of accident caused by mechanical failure will be reduced to a minimum.

b. Summarize with emphasis the purpose of preventive maintenance as follows: *To prevent defective conditions from developing and to locate and correct defective conditions before they have a chance to become serious or cause accidents.*

62. Scope of preventive maintenance by the driver.—*a.* Emphasize that preventive maintenance by the driver includes the following:

(1) Inspecting and servicing the vehicle in accordance with those operations outlined in the preventive maintenance schedules.

(2) Reporting those defects whose repair is not a function of the driver.

(3) Repairing defects which the driver is capable of repairing, equipped to repair, and authorized to repair.

b. Ask the class to give some examples of servicing and repairs which a qualified mechanic is required to perform, but which the average driver is not permitted to undertake. (EXAMPLES: Adjusting distributor points, gaps, and timing; carburetor setting; relining brakes; adjusting bearings; etc.)

c. Emphasize that the Army has set up definite rules limiting the inspection, servicing, and repair operations which a vehicle driver may perform.

d. Stress that the driver should never exceed these limitations and make unauthorized repairs without direct orders, except in extreme emergency when it is essential that the vehicle keep moving and when the assistance of a qualified Army mechanic cannot be secured.

63. Echelon system of maintenance.—State that the Army has separated the work of inspection, servicing, and repairing motor vehicles into four general classifications known as the "four echelons of motor vehicle maintenance," and that the duties performed in each of these are carefully allocated, according to personnel, time, and equipment available.

64. First echelon maintenance.—Write on the blackboard: FIRST ECHELON MAINTENANCE (work which the driver with his limited tools, training, and knowledge is able to perform). Ask the class to give you what, in their opinion, are the maintenance duties of the driver and write those answers, which are officially prescribed as the driver's functions, on the blackboard. These answers should include—

a. Daily inspections (before, during, and after operations, at halts and weekly).

b. Servicing his vehicle and making those minor repairs and adjustments which he is normally authorized to perform, such as tightening loose units and bolts.

c. Reporting to his superior all defects found during inspections which he was unable or unauthorized to satisfactorily correct.

65. Second echelon maintenance.—Write on blackboard: SECOND ECHELON MAINTENANCE (work of mechanics in small mobile shops with limited tool equipment and replacement units). Explain briefly the maintenance services which the second echelon maintenance mechanics perform: replacement and adjustments of minor parts such as spark plugs, fan belt, gaskets, wiring, etc.; small unit assemblies such as fuel pumps, carburetors, batteries, coils; greasing and changing oil; brake adjustments and other adjustments which are too precise for the driver to perform with his limited supply of tools.

66. Third echelon maintenance.—Write on the blackboard: THIRD ECHELON MAINTENANCE (work of mechanics in a mobile shop well-equipped with a large supply of replacement unit assemblies such as wheels, generators, fuel pumps, etc.). Explain briefly the services performed in the third echelon maintenance shop: replacement of unserviceable unit assemblies by assemblies from the third echelon stock. (If repair can be made without removal of unit assembly, it is made.) Repair and overhaul of unit assemblies, such as carburetors, starters, generators, fuel filters, etc. In addition to unit replacement, the third echelon makes repairs involving the use of mobile shop equipment, general mechanics, and a limited number of trade specialists. Since a considerable amount of equipment and

supply is needed, the third echelon maintenance shop would probably be located a short distance behind the actual combat zone. Parts and unit assemblies would be transported from the shop by contact repair sections to disabled vehicles and installed; while in other cases, wrecking crews would haul disabled vehicles back to the shop for repair.

67. Fourth echelon maintenance.—Write on the blackboard: FOURTH ECHELON MAINTENANCE (work of personnel in a mobile shop). Explain that the fourth echelon makes replacements and major repairs of assemblies from salvaged parts. It is located a considerable distance behind the combat zone and salvages and reconditions all the units and vehicles in the particular theater of operations. Its personnel usually consists of a company, battalion, or regiment. It is equipped to undertake all types of automotive repairs including general overhauls and major repairs of vehicles and unit assemblies.

68. Reemphasis of driver duties.—Reemphasize that, except when assigned additional functions in certain emergencies, the driver must perform only the inspection, servicing, and maintenance operations which are specifically delegated to him and which will be thoroughly discussed later in the course.

B—NOMENCLATURE AND FUNCTION OF VEHICLE PARTS

69. General.—*a. Objective.*—(1) To develop in student drivers a general knowledge of the purpose, function, and operation of the major assemblies of the motor vehicles.

(2) To develop in student drivers a realization of the importance of inspecting, servicing, and lubricating their vehicles at regular intervals.

b. Place.—Classroom auditorium or any suitable building where vehicles can be shown (open air, if desirable).

c. Materials.—Quartermaster training films (11–551, reels I and II), photographs; charts of chassis, etc.; "cutaway" major assemblies showing operation of parts; blackboard and chalk of various colors; manufacturer's Maintenance Manuals and Parts Lists; demonstration vehicles of various types.

d. Personnel.—One assistant instructor.

e. References.

TM 10–525, Echelon System of Maintenance.
TM 10–545, Motor Vehicle Inspections and Preventive Maintenance Servicing.
TM 10–1401, Maintenance Manual, GMC 1½-ton 4x4.
Motor Transport School Text No. 16, Military Motor Transportation.

TM 10–460, Driver's Manual.

Manufacturer's Maintenance Manuals and Parts Lists.

f. Note to instructor.—It is important that every driver have a general knowledge of how the power of the motor vehicle is developed and how it is transmitted to the wheels. Even though the driver is not expected to be a mechanic, he will, if he has some knowledge of the construction and functioning of the various parts, be more likely to keep his vehicle in the best possible operating condition, be less likely to strain or otherwise abuse his vehicle, and be better equipped to detect and report vehicle faults in their earliest stages. The circumstances under which this part of the instruction will be carried out and the equipment and teaching aids for this unit vary so greatly that it is difficult to develop any standard procedure which can be followed by all instructors. Therefore, it is suggested that paragraphs 70 to 73, inclusive, be used not so much as a hard-and-fast instructors' guide, but as a reminder of the items that must be covered. You should use your ingenuity in developing ways and means of putting your instruction over effectively. (See introductory note for instructors at beginning of this section.) You may not have cutaway assemblies, but still you will wish to give student drivers a clear picture of what goes on in various inclosed mechanisms of the vehicle. You may do this by disassembling parts of units and demonstrating their operation manually while you explain and while student drivers watch; or you may use enlarged photographs or drawings. You should bear in mind that whatever your procedure your objective is to see to it that student drivers are equipped with a general knowledge of the operation of the major units of the vehicle, and of the importance of inspection, servicing, and repair in keeping those units in proper operating condition. Therefore, you should point out and demonstrate the motion of moving parts; the points at which friction develops; the means by which lubrication is accomplished at these points and the type of lubricants used; the means by which power is transmitted from point to point; all connections which are likely to work loose through vibration (briefly pointing out in each case the means of keeping those connections secure); and ways in which driver neglect, both in maintaining and operating the vehicle, can lead to break-downs.

70. Nomenclature.—Assemble student drivers in a classroom or other place where the driver Training Film 11–551 (reels I and II) can be shown. Introduce the film explaining that it is intended to give the student drivers a bird's-eye view of what is involved in nomenclature and function of motor vehicle parts. After the showing, tell the group that they are now going to study the actual vehicle. (Defer any

questions at this point.) Now assemble student drivers in a shop or other place where you can point out on a demonstration vehicle the following major units of a motor vehicle:

a. The chassis, which consists of the frame, wheels, steering, and braking apparatus, power transmission units, engine and its various auxiliary units and controls.

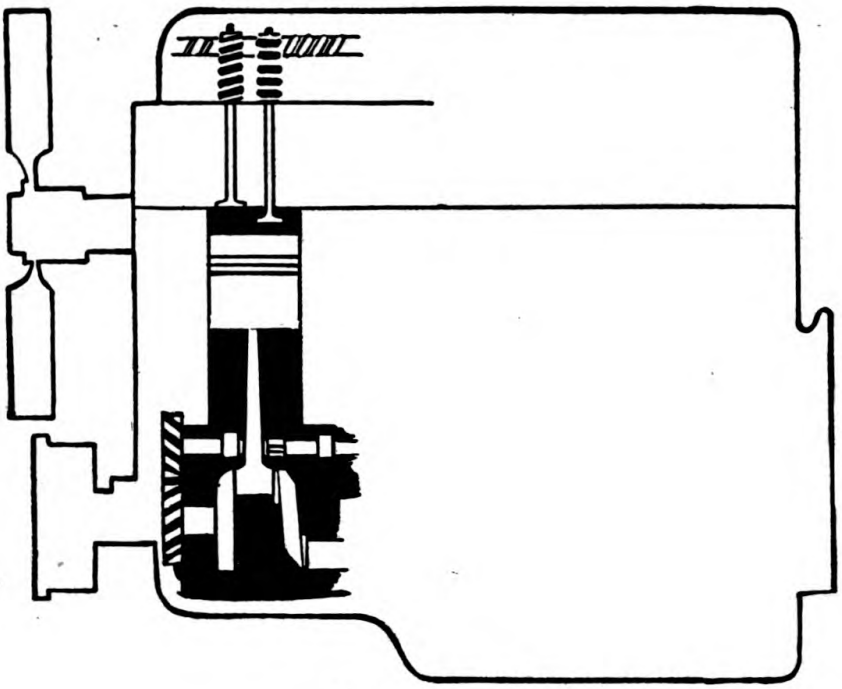
b. The body, which may vary considerably in form according to the use for which it is designed, but which is essentially an inclosure (the cab) to protect the driver from the weather, plus a compartment or platform for carrying cargo. Point out that when you refer to the left side of the vehicle, you will mean the side on which the steering wheel is located, and vice versa.

71. Internal combustion engine.—Explain that the motive power of the motor vehicle is derived from the expansion of a burning mixture of gasoline and air. Point out that burning of the fuel is so rapid that it is commonly described as a combustion. Explain that the gasoline engine is known as an internal combustion engine because "internal" means that the fuel mixture is burned in an inclosed space thus permitting the energy to be released only in a specified direction.

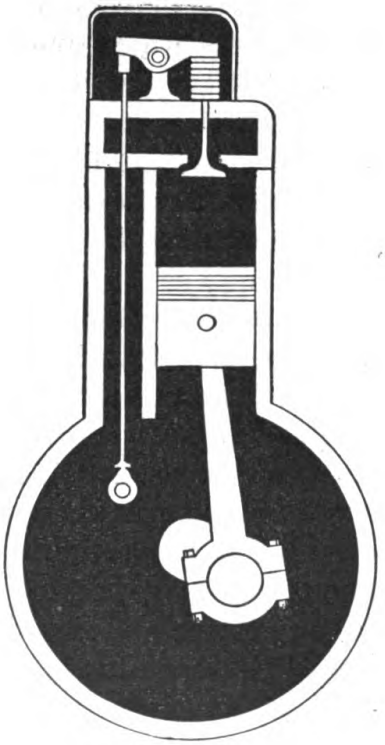
a. Cylinder block and head.—Indicate that in the internal combustion engine, fuel is burned in a series of cylinders which are closed at the top and open at the bottom. Explain that because it is necessary to open the top of the cylinders at times for repairs and assembly, a removable top known as a cylinder head is fastened to the cylinder block by bolts and nuts. A gasket is placed between the head and block. Point out cylinder block and head in enlargement of figure 8 (or fig. 9) or on a cutaway model.

b. Piston.—Point out in enlargement of figure 8 (or fig. 9) or on cutaway model, that a piston fits tightly in the cylinder and is forced downward following each explosion of the fuel mixture in the combustion chamber. Mention that the horizontal lines on diagram indicate location of piston rings. Explain that piston rings are thin flexible metal rings set in grooves around the outside of the pistons and that their purpose is to make gas-and-oil-tight any space that may remain between the piston and the cylinder walls.

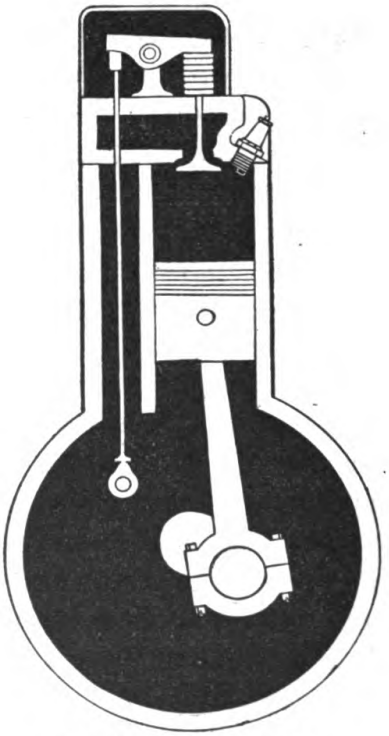
c. Connecting rod, bearing, and crankshaft.—Explain that the connecting rod (fig. 8 or 9; or a cutaway model) is attached to the piston and the crankshaft in such a way that when the piston moves up and down in the cylinder it transforms this up-and-down motion into a turning or rotary motion of the crankshaft. Point out that there is a connecting-rod bearing between the crankshaft and the connecting rod.



① Side view.



② Front view.



③ Position of spark plug.

FIGURE 8.—Cutaway engine.

d. Valves.—Explain that one valve permits the fuel mixture to enter the cylinder, while another valve allows the burned gases to leave the cylinder after the combustion has taken place. Point out that these two valves alternate in operation. When the fuel mixture is entering the cylinder, the exhaust valve is closed. When the exhaust gas is forced out of the cylinder through the open exhaust

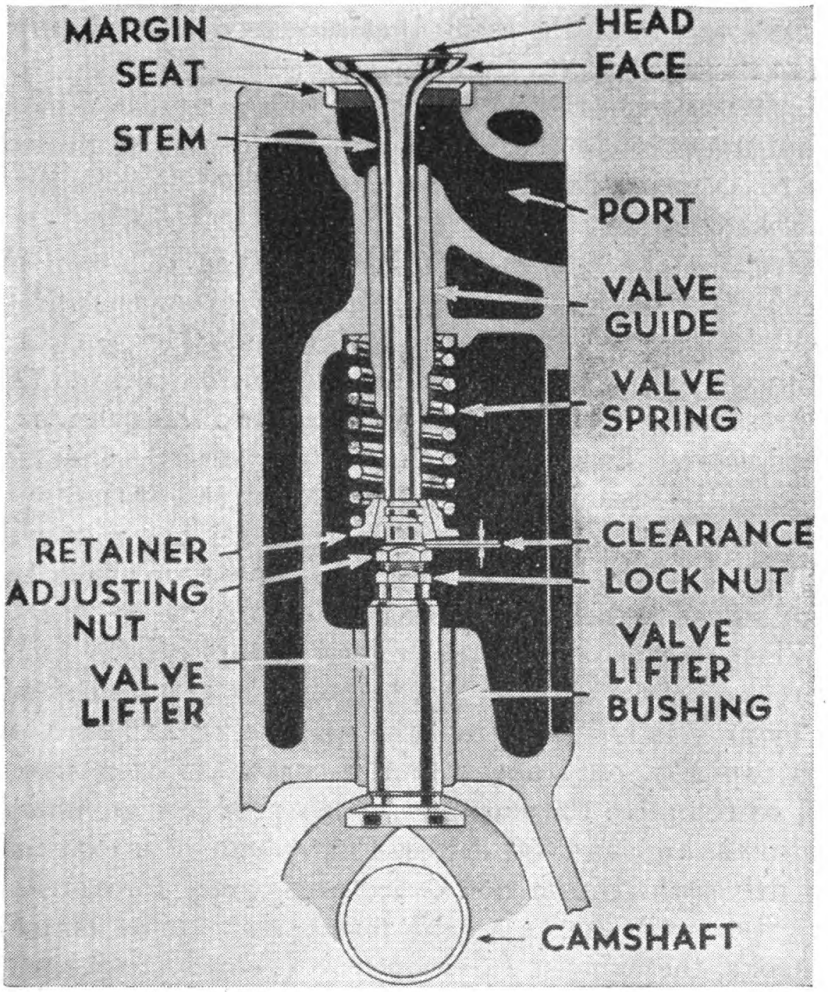


FIGURE 9.—Valve and related parts.

valve, the intake valve is closed. Point out that while the fuel mixture is being compressed and ignited and while it expands, both valves remain closed (figs. 8 and 9).

e. Camshaft.—Now refer to camshaft, as shown in figures 8 and 9 or on cutaway model. Explain that the camshaft is operated by the turning crankshaft and that it in turn opens the intake and exhaust valves alternately.

f. Spark plug.—Point to a spark plug on a vehicle or model (fig. 8③). Explain that an electric spark jumps between the points after

the fuel mixture has been compressed in the cylinder. The spark ignites the fuel mixture which then burns and expands, forcing the piston downward, turning the crankshaft. The crankshaft then furnishes power for the wheels as well as energy to move the other pistons and operate the engine. Point out that the cylinders are arranged in a row above the crankshaft and that as the fuel mixture is exploded in each cylinder in split-second succession, the pistons are in turn propelled downward with the result that successive turning impulses are applied to the crankshaft.

g. Four-stroke cycle.—(1) Point out that each piston moves down twice and up twice in the cylinder in the course of providing one impulse to the crankshaft, and that this series of motions is called the "four-stroke-cycle."

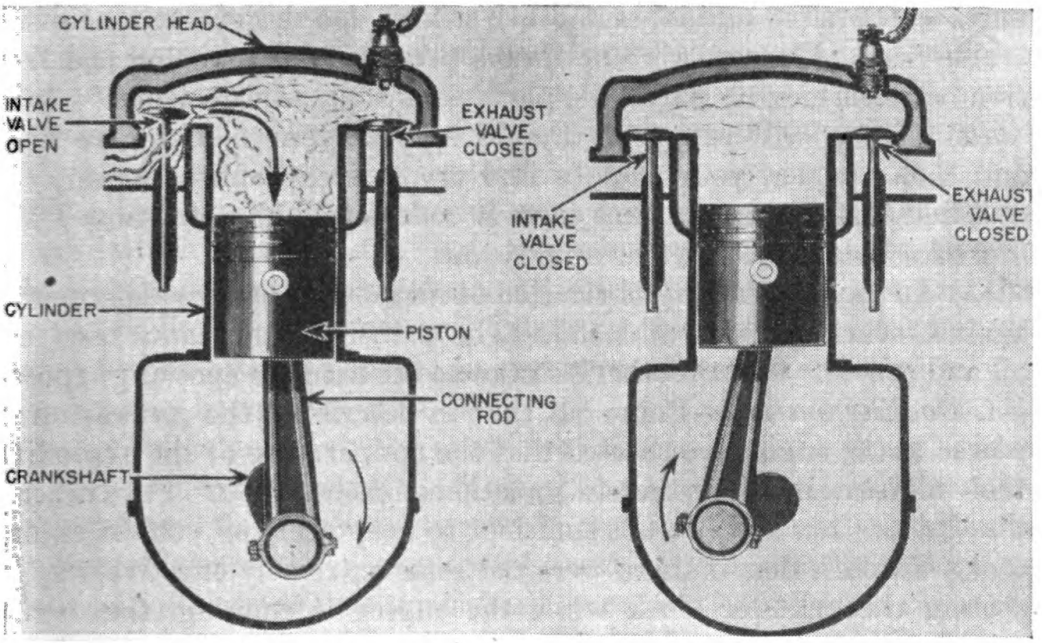
(*a*) Describe the first or "intake stroke" as follows: With the piston at the top of the cylinder, the intake valve opens and the turning crankshaft pulls the piston downward. The partial vacuum created in the cylinder by the descending piston permits the atmospheric pressure to force the fuel mixture into the cylinder through the intake valve. This is the first or intake stroke. (See fig. 10①.)

(*b*) When the piston has reached the lower end of the cylinder, the intake valve closes and as the piston rises the fuel mixture is compressed. This stroke is known as the "compression stroke" and it is the second stroke in the cycle. (See fig. 10②.)

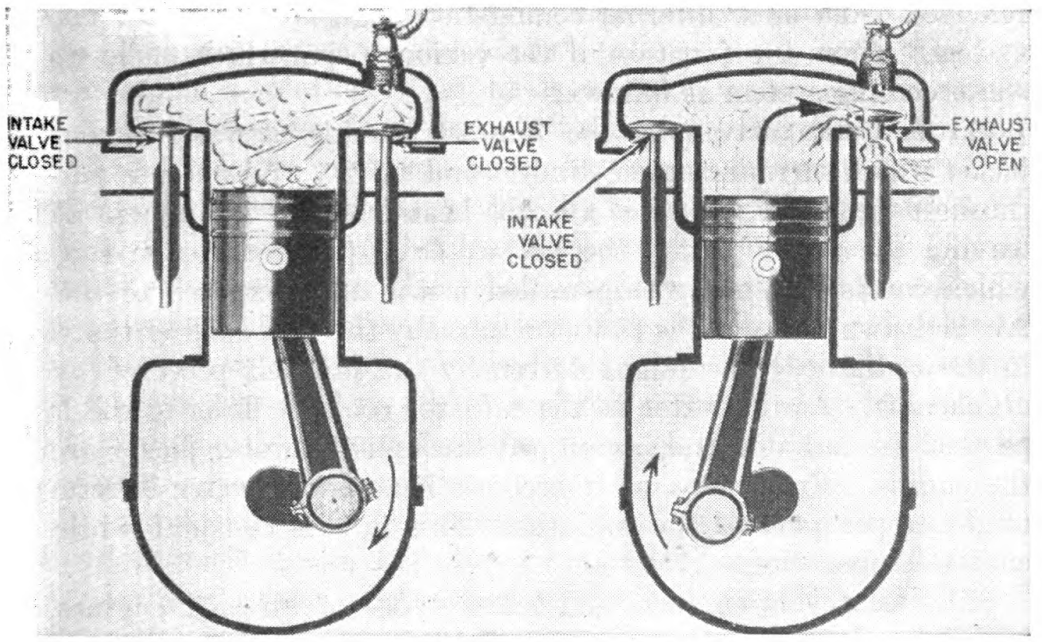
(*c*) When the piston is at its highest point and the fuel mixture is compressed in the cylinder head above the piston, the mixture is ignited by an electric flash from the spark plug. It burns with tremendous rapidity, only about four thousandths of a second being required to complete the burning, which produces an instantaneous temperature as high as 4,000 degrees Fahrenheit. The extremely rapid burning drives the piston downward with great force. This is the third or "power stroke." As the piston reaches the bottom of the power stroke, the exhaust valve opens. (See fig. 10③.)

(*d*) The turning crankshaft now forces the piston upward again and the piston pushes the burned gases out through the exhaust valve. This is the "exhaust stroke." Throughout this entire stroke, the intake valve remains closed. At the end of the exhaust stroke, as the piston reaches the top of the cylinder, the exhaust valve closes. (See fig. 10④.)

(2) Point out that when an engine is running, the four-stroke cycle is repeated with terrific rapidity. In normal operation of a military motor vehicle, this process will occur from 1,000 to nearly 2,000 times a minute.



① Intake stroke. ② Compression stroke.



③ Power stroke. ④ Exhaust stroke.

FIGURE 10.—Events of the complete stroke of four-cycle engine.

h. Lubrication of engine.—Emphasize the importance of motor vehicle lubrication, particularly of moving parts, somewhat in the following manner:

(1) Obviously the wear and tear on the mechanism of a motor vehicle in operation is extremely heavy, particularly in the case of those

parts which move against each other at high speed, generating considerable heat. If there were no means provided for reducing the friction between moving parts, the parts would quickly wear out.

(2) If you will rub your thumbs against your first fingers hard and then moisten your thumbs and try this experiment again, you will find that the second time there is considerably less friction. The film of moisture has acted as a lubricant.

(3) In motor vehicles, lubrication of all moving parts which operate against other parts is essential. The principal lubricants used are oil and grease. Certain other substances are used for special purposes.

i. Cooling system.—Point out that in describing the generation of power in the engine, you stated that the temperature of the exploding fuel mixture in the cylinders sometimes reached 4,000° F. Indicate that lubrication alone is not sufficient to keep a motor vehicle engine cool. Explain that if there were not some extremely effective way of cooling the cylinder block while the engine is running, the engine would soon heat up to a point where the pistons would expand and bind in the cylinders, stopping the engine. Point out that heat is removed from most internal combustion engines by a water cooling system. Show the function of the various parts which make up the water cooling system as follows:

(1) A pump driven by the fan belt circulates water through a jacket which surrounds the cylinders and valves. As water is pumped through the water jacket, it absorbs heat from the cylinders. After leaving the water jacket, the hot water is pumped to the radiator which consists of many thin-walled metal tubes exposed to the air. Air is drawn between the radiator tubes by the fan, cooling the water in the radiator. The fan is driven by the fan belt powered by the crankshaft. As the water in the radiator cools, it flows to the lower part of the radiator and is pumped through the water jacket around the engine. From here, as it becomes heated, the water is returned to the upper part of the radiator. This flow is constant while the engine is operating.

(2) Motorcycle engines, and many types of aircraft engines are cooled by the air-cooling system. In this system the cylinders and cylinder heads are provided with fins which expose a very large heat conducting area to the air. This increased radiating surface permits the heat to be directly absorbed by the air. Point out that at a later point in the course, you will explain the parts and maintenance of the cooling system in detail.

j. Electrical system.—Remind the class that earlier in the discussion of the engine you referred to the electric spark which ignites the

fuel mixture in the cylinders. Point out that in addition to furnishing the spark, electricity is used also to provide power for the lights, starting motor, and any other electrical accessories. Explain briefly that the electrical energy used in operating the motor vehicle is distributed by a system of wires to the various points where it is to be used. In pointing out each electrical unit, indicate very briefly the wires which connect the unit with other units in the system. Emphasize that all electrical connections must be kept tight, and that frayed or broken wires not only interrupt the flow of current but also are a fire hazard, and should be reported as soon as detected so that repairs may be made.

(1) *Generator.*—Ask the question: "Where does the vehicle's electrical power come from?" (Most of the answers will be, "from the battery", and this in a sense is correct, but mention that the continuous supply of electrical energy comes from a generator driven by the engine.) Point out that the battery stores for future needs the excess of electricity produced by the generator, above that which is being actually used at the time.

(2) *Battery.*—Explain that the storage battery contains a number of positive and negative lead plates insulated from each other and submerged in a solution of sulphuric acid and water. Point out the following: The water from the solution surrounding the plates evaporates and must be replaced in the battery at frequent intervals or the plates will deteriorate, ruining the battery. The battery should be kept filled by adding distilled water to the level specified by the manufacturer, which is always above the tops of the plates. The battery plates are connected to terminals which protrude through the cover of the battery. Indicate that one of these terminals is connected to the starting motor and the vehicle's electrical circuits, while the other is grounded to the frame of the vehicle to complete the circuit.

(3) *Condenser and coil.*—Indicate that current passes through a coil which steps up the six volts of the battery to between 10,000 and 20,000 volts to produce a "hot" spark across the spark-plug gap.

(4) *Distributor.*—Point out that a split-second firing arrangement is necessary. The current as it goes on its way to the spark plugs passes through a distributor. This assembly switches the current on and off and distributes it in such a way that the current is supplied to the individual spark plugs at the proper time and in the proper sequence for firing the compressed fuel mixture in the cylinders. Point to the distributor, the distributor cap, rotor arm, breaker points, and the wires which lead to the spark plugs.

(5) *Starting motor and starter switch.*—Describe the starting motor and starter switch as follows: Modern vehicles are equipped with an electric starting motor which receives its power from the battery. This motor cranks the engine turning it over and putting the engine into operation. When the starter switch is depressed, the starting motor is automatically geared to the engine by means of a gear on the rim of the flywheel. The gear connection with the engine is broken as soon as the current to the starter motor is shut off. The driver should *immediately release* the starter switch as soon as the engine starts. Failure to do this may cause serious damage to the starting motor or gears.

(6) *Ignition switch.*—Point out that an ignition switch in the cab is provided for the purpose of breaking the electrical circuit so that the engine may be stopped. When the switch is turned off, the engine stops because the electrical circuit that passes the current into the spark plugs is broken. Emphasize that this switch should be turned off when the engine is not being operated.

(7) *Ammeter.*—Refer to the ammeter as an electric current indicator, located on the instrument panel. Its purpose is to inform the driver whether or not the generator is charging the battery properly when the engine is running. Add that it also indicates the amount of electrical current consumed by the lights and accessories.

(8) *Headlamps.*—Point out that most modern headlamps are sealed in a single unit consisting of the lamp and reflector. Explain as follows: The lamps are equipped with two filaments so arranged that one throws light straight ahead, and the other throws a beam downward and to the right. Both are turned on or off by a switch on the instrument panel. The choice of the high or low beam is controlled by a foot-operated switch usually located on the floor to the left of the steering column, near the clutch pedal. The foot switch turns the direct beam off at the same time it turns the downward on, and vice versa when the foot is raised.

(9) *Fuses or circuit breakers.*—Point out that a fuse is provided in the electrical circuit so that should a short circuit occur or should the circuit be overloaded to a dangerous point, the fuse will blow out and break the circuit. Emphasize that the driver should carry spare fuses on his vehicle at all times and should know how to replace burned-out fuses. Add the following: Some vehicles are equipped with a thermal type fuse. Heat due to resistance caused by shorts will cause this type of fuse to break the circuit. When the thermal fuse cools, the circuit will be restored. Therefore, should this happen, the driver should turn off the switch and look for and report the trouble.

k. Fuel system.—(1) *General.*—Mention that you have already told the class that the source of power in this internal combustion engine is gasoline. Explain the following:

(*a*) Gasoline is supplied to the engine from a fuel tank, which is kept closed by a filler-pipe cap at all times except when the vehicle is being refueled. There is a small airhole in this filler-pipe cap which lets air into the tank so that there will not be a vacuum created when the fuel is withdrawn to flow through the lines.

(*b*) The driver should know at all times how much fuel is in the tank. You all know how dangerous it is to light a match and look into a gasoline tank. Inserting a stick or other measuring implement into the tank is not good practice since it gets dirt into the fuel. So a gage is provided in the cab to show the driver how much fuel is in the tank. This fuel gage is electrically operated by a float which rises and falls in the tank according to the level of the fuel.

(*c*) Fuel is transported from the tank to the engine by a metal tube. Care is taken to locate the tube away from any hot metal parts since this might cause vapor to form in the line producing "vapor lock" and causing the engine to stop.

(*d*) In modern motor vehicles, fuel is pumped to the engine by a mechanical pump operated by an eccentric or cam located on the camshaft.

(*e*) Army motor vehicles are equipped with two filters which remove the dirt from the fuel before the fuel enters the engine. One of these is in the fuel line between the tank and the pump, and the other is built into the pump itself. The screens in these filters remove all particles of dirt which sink to the bottom of the filter cups. These fuel-filter cups should be checked and cleaned weekly (more frequently in dusty country).

(2) *Carburetor.*—Point out how the fuel goes from the pump to the carburetor. This is a metering or measuring device which atomizes the gasoline into a fine spray and mixes it with the proper proportion of air so that this mixture can be drawn into the cylinders in the form of a vapor. Emphasize that the mechanism of the carburetor is so complicated that only skilled mechanics are authorized to adjust it. Stress that the Army has made the maintenance of carburetors a duty of mechanics, not of drivers.

(3) *Throttle valve.*—Point out that attached to the carburetor is a lever which opens or closes a throttle valve regulating the amount of gasoline-air mixture entering the cylinders. Indicate that this lever is connected by linkage to a foot control or accelerator which regulates the speed of the engine.

(4) *Choke.*—Explain the following: When the engine is cold as is the case when starting in cold weather, the gasoline does not vaporize readily, and a richer mixture (one with less air and more gasoline) is needed. To assist starting when the engine is cold, a second valve is attached to the carburetor which is called the choke. The choke is controlled by a button in the cab. When the control is settled out, it reduces the amount of air entering the carburetor. The choke button should always be pushed in as soon as the engine has warmed up. If this is not done, the engine will "miss" and lose power, gasoline will be wasted, crankcase oil diluted, and excessive carbon formed.

(5) *Air cleaner.*—Point out the air cleaner, which is a filter attached over the air intake of the carburetor. Explain that this filter prevents dust or other foreign matter from being drawn into the engine and damaging cylinders and pistons.

(6) *Intake manifold.*—Indicate that after passing through the carburetor, the fuel mixture is distributed to the intake valves of the various cylinders by an arrangement of pipes known as the intake manifold.

l. Exhaust system.—(1) *General.*—Point out that after the fuel mixture has been burned in the cylinders, the burned gases leave the cylinders through the exhaust valves and the exhaust manifold. Point out that the exhaust manifold is generally located close to the intake manifold so that the heat of the burned gases in the exhaust manifold can be used to heat the fuel mixture before it enters the cylinders increasing the vaporization of the gasoline.

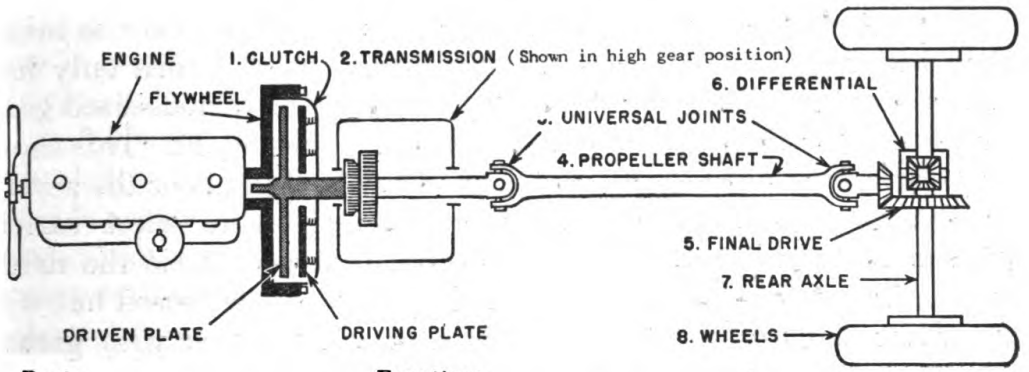
(2) *Muffler.*—Mention that the burned gases in the exhaust pipe pass through the muffler which quiets the noise of the explosions. Point out that after passing through the muffler, the burned gases continue outward into the air through the exhaust pipe. Ask for questions and clarify any points not clear. Avoid going into any details on any parts whose preventive maintenance is not a specific function of the driver.

72. Power train.—To give reality to discussion of power train refer frequently to an enlargement of figure 11 or to parts of a demonstration vehicle. Point out that even though an engine may have as many as eight, twelve, or more cylinders and each piston completes the four-stroke cycle with tremendous rapidity, the application of power to the crankshaft would still be jerky, with the result that the engine would vibrate considerably, unless some means were provided to smooth out the individual impulses into a continuous application of power.

a. Flywheel.—Explain that this smoothing out is accomplished by a sturdy flywheel attached to the crankshaft at the rear end of the engine. The flywheel stores up the energy of the successive impulses and returns it to the crankshaft in a steady flow of power. Point out the flywheel, and call attention to its weight and its location (either by drawing a diagram of it on blackboard, or by pointing out flywheel on demonstration vehicle).

b. Clutch.—Explain the clutch mechanism as follows (see fig. 11):

(1) The clutch is a friction device which provides the means of disconnecting and reconnecting the engine power to the wheels.



Parts *Functions*

1. Clutch—transfers power rearward by means of friction.
2. Transmission—permits selection of various speed gears.
3. Universal joint—transfers power at various angles.
4. Propeller shaft—transmits rotary power.
5. Final drive—transfers power at right angles and increases pulling effort.
6. Differential—permits driving wheels to turn at different speeds.
7. Rear axle—transmits rotary power.
8. Wheels—drive vehicle.

FIGURE 11.—Power train.

(2) As a driver, you'll merely press down the clutch pedal when you want to disconnect the engine power. But what happens when you do press the pedal down? You are releasing what is called the driven plate from the flywheel. The power then goes no farther than this flywheel.

(3) When you let the clutch pedal up, this happens: The clutch driving plate is pressed against the driven plate, which is nothing more than a disk surfaced on both sides with a material having high frictional qualities. This plate, in turn, is pushed against the flywheel and this driven plate begins to spin, turning the gear to which it is attached in the transmission.

c. Transmission gears.—Point out that the power furnished by the engine must often be concentrated so that a great deal of work can be performed, as when the vehicle carrying a heavy load is driven up a

steep hill. Indicate that at other times only a relatively small amount of power is needed to drive the vehicle, as when driving on a level highway. Point out that for these reasons a means is provided by which the driver can select various gears. The driver can use a gear position to have the engine turn over a great many times and advance the vehicle very slowly, but with great concentration of power at the driving wheels. Another gear selection is used to move the vehicle more rapidly, but with less concentration of power at the driving wheels. Describe how a set of gears accomplishes this by operating on the following principle: When one gear is turning a larger gear that has twice as many teeth, the smaller gear must make two revolutions to turn the larger gear around once. The result will be that the larger gear will be given twice the turning force, but will turn only half as fast as the smaller gear. The whole assembly of various-sized gears in a motor vehicle is called the transmission. (See fig. 11. This shows only two of the many gears in this assembly.) Tell about the several transmission gear ratios which permit the driver to select various concentrations of power. Depending on what gear ratio the driver selects, the vehicle will move forward either at greater speed but with less force being applied at the wheels, or at less speed with greater force being applied at the wheels. Mention that there is also another gear (reverse) which permits the engine to drive the vehicle backward. Because heavy-duty vehicles require a greater selection of gears than those included in the regular transmission, some Army vehicles are equipped with one or two additonal sets of gears to provide still greater concentrations of power. These gears are located in a case between the regular transmission gears and the driven axles. They are called the transfer-case gears. Point out that if the driver is to be able to shift gears as necessary, some mechanism must be provided by which he can engage various sets of gears at will. State that this mechanism is known as the gearshift. Point to the transmission gearshift lever and transfer-case shift lever in the cab. Explain that when a motor vehicle is being driven, at least two transmission gears are meshed and turning, and that in the case of some Army vehicles, the transfer-case gears may also be meshed and turning. Next, explain that if the driver were to attempt to engage a turning gear which was not turning, the teeth of both gears could be broken and possibly the entire transmission would be smashed. Consequently it is necessary to press down the clutch pedal and disconnect the engine power from the transmission while the gears are being shifted.

d. Universal joint.—Point out the universal joint (fig. 11). Explain that with the clutch engaged, and the power being delivered

through the transmission gears, it is necessary to have some sort of mechanism to provide flexibility in the turning shaft. The universal joint is the flexible joint in the propeller shaft which allows the rotary power to be transmitted to the driving wheels at short variable angles as the vehicle goes over bumps, up and down hills, etc.

e. Propeller shaft and slip joint.—Point out that to reach the driving wheels, the rotary power must be carried rearward a considerable distance. This is accomplished by the propeller shaft. Now, point out the slip joint, which allows the propeller shaft to vary in length.

f. Final drive.—Point out that from the propeller shaft, the direction of power must be changed so that it can turn the axle and consequently turn the wheels. To do this we have a set of two bevel gears, one is attached to the propeller shaft, and the other attached to the driving axle. The complete assembly is called the final drive.

g. Differential.—Ask the class to imagine a vehicle with driving wheels turning at the same speed, and ask what would happen to those wheels as the vehicle was driven around a curve? (The outside wheel would travel a greater distance than the inside wheel. For analogy, mention that when a column right is performed, the man on the inside takes only very short steps and covers little distance, whereas the man on the outside of the turn must take several large steps to complete the turn. Now on the vehicle, either the outside wheel would be dragged along the road surface as it rounded the curve, or the inside wheel would be held back an equal amount as it rounded the curve, or both wheels would slip.) Point out that this slipping would result in heavy strain on the axle, wheels, and entire transmission. It would also cause rapid wear of the tires. Ask what sort of device would most satisfactorily solve the problem? (An arrangement which would allow the wheels to turn independently of each other.) Point out the differential gear and explain that this is a complicated mechanism providing more power to the outside wheel when turning, and less power to the inside wheel. So the differential allows the two wheels, which are on independent axles, to rotate at different speeds.

h. Transfer case.—Point out that most motor vehicles are equipped with an auxiliary gear box known as the transfer case. Power enters this case by a shaft from the transmission, and is transferred by this case to the shafts driving the front and rear axles. Mention that the shaft to the front axle may be connected or disconnected from the power train by operating a lever in the cab. The transfer case generally has a high and low speed controlled by another lever in the cab, by means of which the pulling effort can be increased similar to the action of the transmission.

i. Front-wheel drive.—Call attention to the shaft from the transfer case that transmits power to the front wheels. Explain that a lever in the cab controls the connecting and disconnecting of the front axle. The purpose of the front-axle drive is to furnish additional traction and driving effort for the vehicle when traveling over rough terrain cross country, or when the going becomes extra tough.

73. Other major assemblies.—*a. Frame.*—Ask the class to explain why the frame is called the structural center of the vehicle. (In addition to carrying the load, it furnishes the support for the body, engine, transmission system, and other units, and maintains their correct relationship to each other. This keeps these assemblies functioning correctly, assures their normal function free from stress or strain and wear that might have been caused if they were misalined.)

b. Springs.—Point out the springs, explaining that these are generally a number of flat metal strips or leaves bound together. Indicate that they are fastened to the frame of the vehicle by shackles and to the axle by U-bolts. Point out the bumper block which keeps the axle from striking the frame of the vehicle.

c. Shock absorbers.—Point out the shock-absorber mechanism, shock-absorber arm, and their linkage to the axle.

d. Live and dead axles.—Ask for the meaning of the term dead axle. (A dead axle transmits no power to the wheels. A live axle does transmit such power.)

e. Wheels.—Point out the wheels and mention that the number of wheels varies with different vehicles.

f. Torque rods.—Explain that torque rods divert twisting or wrenching efforts of the propeller shaft to the frame, so that torque reaction on the springs and rear-axle housing will be relieved. On six-wheel drive military motor vehicles, torque rods connect the forward rear axle with the rearward rear axle. This assembly is known as the "bogie."

g. Brakes.—Point out that good brakes are perhaps the most important safety device on the vehicle. Give the following example of the gripping power of good brakes: A passenger car with an 80-horsepower engine can be accelerated from a standing start to 80 miles an hour in 36 seconds. If the brakes are applied with full force, the vehicle can be stopped in 4½ seconds. The braking force is therefore eight times the power developed by the engine or 640 horsepower. Point out that all service brakes operate on the same principle, that anchored brake linings are forced outward against a circular drum on the revolving wheel, using friction to slow or stop

the rotation of the wheel as pressure is increased. Mention that there are several means of applying leverage to the brake shoes on which brake linings are mounted. Demonstrate and explain the following types of brakes:

(1) *Mechanical.*—The first and earliest means to be developed was a series of cables or rods leading from the driver's brake pedal to the brake shoes. This mechanical brake system is used only for the parking or emergency brake system on recent-model vehicles.

(2) *Hydraulic.*—Hydraulic brake operation is most commonly used on present-day motor vehicles. In the hydraulic system, the brake pedal operates a piston in a master cylinder which is filled with a fluid. The master cylinder is connected by strong tubes to the other small cylinders at the brake shoes. When the driver pushes down the brake pedal, the piston in the master cylinder forces the liquid equally through the tubes to pistons in the brake-shoe cylinders. These cylinders in turn have pistons operated by the fluid, which force the brake shoes against the drums.

(3) *Air.*—In the air-brake system, compressed air from a tank is forced into brake chambers. This air operates a diaphragm which in turn moves a pushrod connected by linkage and cams to the brake shoes. The high air pressure required is supplied by an air compressor run by the vehicle's engine. Because air brakes are extremely powerful, they are used extensively on heavy vehicles.

(4) *Electrical.*—Trailers often have electrical brakes, in which electric magnets move the brake shoes. One of the advantages of electric brakes is that they need no elaborate connections between the brakes and the source of power.

(5) *Vacuum.*—In the vacuum-brake system found on some types of heavy vehicles, the brake pedal in the cab operates a control valve. Opening this valve permits the vacuum produced in the intake manifold to exhaust the air from a cylinder, moving a piston. The piston, in turn, applies additional pressure to the master cylinder of the hydraulic brakes.

h. Steering mechanism.—Describe the major parts of the steering system as follows: The steering wheel turns a steering-column shaft. At the bottom end of the shaft is a gear arrangement which moves a steering-knuckle arm generally attached to the left steering knuckle by a drag link. The turning motion of the left front wheel is imparted to the right front wheel by a tie rod. Some variations of this linkage are in use. The steering motion is transmitted to the front wheels through the steering knuckle, which is roller-bearing mounted on the front axle housing.

Emphasize that proper maintenance of the steering assembly is essential to the safety of the vehicle and the driver. Point out that these parts have many connections of various types between the steering wheel and the wheels and that all of these must be kept properly tightened, lubricated, and in perfect working order or the steering apparatus may fail while the vehicle is being driven. Explain that the driver can detect faults in the steering assembly at an early stage by excessive "play" in the steering wheel, front-wheel shimmy, extremely hard steering, failure of the wheels to turn the full distance they should turn, or by wheels pulling the vehicle to one side. Emphasize that any of these symptoms are danger signals which should be promptly corrected. However they are less likely to occur if the driver regularly performs the inspections and maintenance services assigned to him. Mention that instruction in these duties will be given later in the course.

i. Miscellaneous accessories.—Point out all accessories attached to the frame, paying particular attention to those which are designed for the protection of the vehicle, such as fenders, bumpers, running boards, headlamp brush guards, and spare tire rack.

C—NOMENCLATURE AND FUNCTION OF VEHICLE TOOLS

74. General.—*a. Objective.*—To develop in student drivers an understanding of the purpose and function of the tools supplied with their vehicles.

b. Place.—Classroom in which a vehicle can be placed, or field.

c. Materials.—Set of driver's tools; one or more vehicles.

d. Reference.—Manufacturers' Maintenance Manuals.

e. Note to instructor.—Assemble student drivers in classroom, then lay out a standard driver's tool kit and explain that these are the tools furnished with each vehicle. Demonstrate use of each tool on the demonstration vehicle briefly describing the tools as in the following paragraphs.

75. Cross-recess screw drivers.—Explain that cross-recess screw drivers are furnished in different sizes to fit various sized Phillips screws. The cross-recess screw driver is easily centered on the screw head. The ordinary screw driver used on the ordinary screw frequently gets off center.

76. Plain screw drivers.—Point out that the plain screw driver should not be abused; that is, used as a chisel, hammer, or prier.

77. Spark plug socket wrench.—Explain that it is necessary to insert the spark plug socket wrench in the depressions in the cylinder head in which the spark plugs are set when removing, replacing,

or tightening spark plugs, as an ordinary wrench would not reach the nut in which the spark plug is set.

78. Set of double-end wrenches.—Explain that double-end wrenches are furnished in different sizes to fit various sized nuts on the vehicles.

79. Adjustable wrench (crescent).—Point out that the adjustable crescent wrench is so designed that there is less chance of breakage as it is turned in the direction of the movable jaw. Mention that drivers should avoid turning it in the opposite direction except under circumstances where it cannot be fitted and turned in the proper direction, and that under such circumstances drivers should avoid overforcing the wrench.

80. Adjustable wrench (monkey wrench).—Point out that the adjustable monkey wrench is more bulky than the crescent wrench and consequently cannot be fitted into such confined spaces. However, it is extremely sturdy and can be fitted so that the jaws will grip the nut vertically while the handle is rotated in a turn-table motion.

81. Ball-peen hammer.—Explain that the ball-peen is used to straighten bent vehicle parts in an emergency; it is used in changing tires, and may be also used as an ordinary hammer.

82. Starting crank and bumper bracket.—Point out that the starting crank may be used to crank the engine when the battery will not furnish sufficient energy to turn over the engine. Add that it may sometimes be used to crank the engine a few times with the ignition off before starting to reduce stiffness of oil in cold weather, thereby reducing wear on the battery. Show how the crank-handle bracket is fixed to the bumper to provide a firm support when cranking.

83. Lifting jack.—State that the jack is used whenever it is necessary to raise any part of the vehicle. It is operated by the lifting-jack handle which turns a gear in the jack that raises the vehicle by means of a threaded screw.

84. Tire iron.—Explain that the tire iron is used as a wedge and lever when mounting and dismounting tires.

85. Tire gage.—Explain that the tire gage is used to check the air pressure in the tires so that the driver may always keep the pressure at point specified by the tire manufacturer.

86. Wheel-bearing nut wrenches, wheel wrench, wheel-wrench handle.—Explain that these wrenches are used to remove specially shaped nuts on the wheel and axle assembly when removing and replacing wheels; that their use is necessary because ordinary wrenches will not fit.

87. Lubrication gun.—Point out that the grease gun is furnished on all vehicles but that the driver is not to grease the vehicle completely or to any great extent except when second echelon maintenance mechanics are not available to do the greasing. Add that later in the course the drivers will have an opportunity to watch and assist mechanics in greasing vehicles so that they will be able to perform this operation when in the field.

88. Oilcan.—Point out that all vehicles are provided with oilcans; that the oilcan is kept in a bracket in the cab when not in use, and that its nozzle should be kept clear of dirt and sediment. Point out that obviously the limited number of tools given to the driver limits the amount of servicing and repair work which he can perform; that later in the course drivers will get practice in the use of these tools and specific instructions in the extent to which they can perform servicing and repair duties; that tools should at all times be kept clean and oiled sufficiently to keep from rusting, and that they should be kept in the tool kit (oilcan excepted) when not in use.

D—SCHEDULE SYSTEM OF PREVENTIVE MAINTENANCE

89. General.—*a. Objective.*—To develop in student drivers the ability to inspect, adjust, and service parts of the vehicle in accordance with the duties assigned to them in first echelon preventive maintenance schedules.

b. Place.—Shop; field.

c. Equipment.—A sufficient number of vehicles to permit student drivers to obtain adequate practice in time available; driver tool kits, including grease guns and tire gages; at least one copy each of Preventive Maintenance Schedules Nos. 2, 3, 4, 5, and 6 for each driver and assistant instructor. (If necessary, one copy of a schedule may be used a number of times by erasing any marks on it.)

d. Personnel.—One assistant instructor for each student driver or group of student drivers.

e. References.

TM 10–545, Motor Vehicle Inspections and Preventive Maintenance Servicing.
TM 25–10, Motor Transport.

90. Rules for handling fuels and lubricants.—Assemble student drivers and assistant instructors around vehicles and briefly and emphatically state the following fire-prevention rules and other cautions which drivers should always observe in the presence of, or when handling, motor vehicle fuels and lubricants.

a. It is good practice not to smoke or light matches when operating a motor vehicle or when standing within 25 feet of one, especially when it is being refueled.

b. Do not smoke or light matches when in a shop where gasoline and oil are exposed because, even though the flame or a spark may not come in direct contact with the fuel or lubricant, it may ignite inflammable fumes in the air.

c. Keep all fuel containers tightly closed except when actually in use.

d. After filling fuel or lubricant containers and pouring fuel or lubricant from such containers into the vehicle, wipe all surplus fuel or lubricant from the outside of the container.

e. Fuel should not be spilled but in event it is, wipe up with a piece of waste and discard waste in a safe place. Otherwise spontaneous combustion may result.

f. Never permit dust or other foreign matter to get into fuel, lubricants, engine, or gasoline tank. Before adding oil, wipe the oil measure, the spigot on the oil drum, the funnel, and the oil filler pipe with a clean cloth. Before adding fuel, clean nozzle of fuel hose.

g. When refueling vehicle, always touch the filler-hose nozzle to the side of the fuel tank on the vehicle before opening the tank. This will discharge any static electricity present and prevent any spark of static electricity from igniting the fuel.

h. In the event of an oil or gasoline fire, never use water to extinguish it. Oil or gasoline will float on water. Therefore the use of water will tend to spread the fire. Sand, dirt, ashes or fire extinguishers containing carbon dioxide or carbon tetrachloride are effective in smothering gasoline and oil fires. The fire extinguisher in the cab of the vehicle you will eventually drive contains either carbon dioxide or carbon tetrachloride.

i. Do not permit fuel or lubricant to get on tires or other rubber parts as they are destructive to rubber.

j. Never park a vehicle so that the tires are in grease or oil.

k. Do not permit oil, fuel, or grease to remain on hands, arms, or clothing longer than is absolutely necessary. Many people get skin eruptions from contact with these substances. All of them are destructive to fabrics.

91. Causes of vehicle break-down.—Point out that you have already shown some of the chief causes of vehicle break-down, such as—

a. Failure to properly lubricate the vehicle.

b. Failure to tighten loose nuts, bolts, screws, and connections.

c. Failure to keep the water cooling system and crankcase filled properly.

d. Abusive driving (such as scraping tires against curbs, racing cold motors, etc.).

92. Progressiveness of vehicle failure.—Emphasize that almost all motor vehicle failure is progressive and that many of the troubles which lead to eventual break-down can be discovered and corrected at an early stage.

93. Preventive maintenance schedules.—Explain that because the fact stated in paragraph 92 is true, definite schedules have been set up by which Army drivers may regularly inspect and service their vehicles. In this way they can detect and correct, or report faulty conditions at an early stage. Explain that these schedules define the preventive maintenance duties of the driver and that they are set up so the duties included in each are to be performed at a certain specified time. Emphasize that, except when directed to do so in an emergency, drivers should not operate vehicles with uncorrected serious defects that they have already reported.

94. After-operation schedule (PMS No. 2)—Importance and general nature.—Distribute mimeographed copies of the after-operation schedule (PMS No. 2) *after* you have commented generally concerning its importance and nature. In your statements, cover the following points:

a. After-operation preventive maintenance is particularly important because at this time the driver inspects his vehicle to detect any deficiencies that may have developed and corrects those he is permitted to handle. He should report promptly, to his chief of section or other designated individual, the results of his inspection. If this schedule is performed thoroughly, the vehicle should be ready to roll again on a moment's notice. The before-operation schedule (PMS No. 3) is then necessary only to ascertain whether the vehicle is in the same condition in which it was left after the after-operation PMS. (See fig. 12.) The after-operation PMS should never be entirely omitted even in extreme tactical situations but may be reduced to the bare fundamental services outlined for the at-halt schedule (PMS No. 5).

b. When performing the after-operation PMS, the driver must remember and consider any irregularities noticed during the day in the before-operation, during-operation, and at-halt PMS's.

c. Permit students to look through the schedule for a few minutes, and indicate that questions will be answered after demonstration.

PREVENTIVE MAINTENANCE SCHEDULE - WHEELED AND HALF-TRACK MOTOR VEHICLES

AFTER OPERATION

FIRST ECHELON (FOR TRAINING PURPOSES ONLY)

PURPOSE: To prepare the vehicle to operate again at a moment's notice

DRIVER'S TRIP TICKET AND PERFORMANCE RECORD (W.D., Q.M.C. FORM NO. 237 - Revised 1942) should be prepared for items needing 2nd Echelon attention as listed below or as noted during the P.M.S. No. 3, No. 4 and No. 5.

LEGEND: √ for "Satisfactory." O for "Not Satisfactory."

IN CAB - BEFORE STOPPING ENGINE	
2-1. Hand brakes	
2-2. Engine noises - Smoothness of idle	
2-3. Temperature gage	
2-4. Oil pressure gage	
2-5. Viscometer	
2-6. Ammeter	
2-7. Voltmeter	
2-8. Tachometer	
2-9. Air brake pressure gage	
2-10. Fuel gage	
2-11. Windshield wipers	
2-12. Heater and defroster	
UNDER HOOD - ENGINE STILL RUNNING	
2-13. Engine	
2-14. Fan belt	
2-15. Ignition wires	
2-16. Carburetor	
2-17. Engine mounting bolts	
2-18. Carburetor controls	
2-19. Fuel and oil lines	
2-20. Accessories	
IN CAB - AFTER STOPPING ENGINE	
2-21. Horn	
2-22. Fire extinguisher	
2-23. Rear-view mirrors	
2-24. Ammeter	
2-25. Voltmeter	
UNDER HOOD - ENGINE STOPPED	
2-26. Radiator	
2-27. Water leaks	
2-28. Fan belt	
2-29. Engine oil	
2-30. Breather cap	
2-31. Air cleaner	
2-32. Spark plugs, distributor, coil, and wiring	
2-33. Fuel leaks	
2-34. Clean as required	
UNDER VEHICLE	
2-35. Steering mechanism	
2-36. Spare tire and carrier	
2-37. Springs and suspensions	
2-38. Brake lines	
2-39. Air brake reservoirs	
2-40. Driving axles	
2-41. Transmission	
2-42. Transfer case	
2-43. Muffler tail pipe	
2-44. Propeller shafts	
2-45. Clean and lubricate any parts that inspection indicates require it	

FIGURE 12.—Preventive maintenance schedule No. 2.

NOTES

WHY PREVENTIVE MAINTENANCE IS NECESSARY AFTER OPERATION

After-operation preventive maintenance is particularly important because at this time the driver inspects his vehicle to detect any deficiencies that may have developed and corrects those he is permitted to handle. He should report promptly, to his chief of section or other designated individual, the results of his inspection. If this schedule is performed

2-46. Tires			2-56. Tractor fifth wheel and plate	
2-47. Hydraulic brakes			2-57. Trailer lighting and brake connections	
EXTERIOR			2-58. Rollers, front	
2-48. Lights and warning reflectors			2-59. Tracks	
2-49. Windshield			2-60. Track suspensions	
2-50. Wheel and axle-flange nuts			2-61. Sprockets	
2-51. Brake drums and wheel hubs			2-62. Refuel tank	
2-52. Sheet metal			2-63. Tools, traction devices, and other equipment	
2-53. Power take-off and winch			2-64. Grousers	
2-54. Bumpers, towing hooks, pintle, and safety chains				
2-55. Load, tarpaulin, and fastenings				

REPORT RESULTS PROMPTLY TO CHIEF OF SECTION OR OTHER DESIGNATED INDIVIDUAL.

REMARKS:

Vehicle (U.S.A. Registration No.)_____

Mileage_____

Date_____

Signed _____
Driver

5-20-42

FIGURE 12.—Preventive maintenance schedule No. 2—Continued.

thoroughly, the vehicle should be ready to roll again on a moment's notice. The before-operation preventive maintenance (PMS No. 3) is then necessary only to ascertain whether the vehicle is in the same condition in which it was left after the after-operation PMS.

The after-operation PMS should never be entirely omitted even in extreme tactical situations but may be reduced to the bare fundamental services outlined for the at-halt preventive maintenance (PMS No. 5).

When performing the after-operation PMS, the driver must remember and consider any irregularities noticed during the day in the before-operation, during-operation, and at-halt PMS's.

The after-operation PMS consists of inspecting or testing the following units and correcting or reporting any deficiencies.

DESCRIPTION OF PREVENTIVE MAINTENANCE SCHEDULE NO. 2

2–1. Hand brakes.—Hand brake lever ratchet should keep lever in applied position and brakes should hold.

2–2. Engine noises—smoothness of idle.—Note whether engine idles smoothly. Also investigate any unusual noises noticed during operation.

2–3. Temperature gage.—When vehicle is stopped and engine is idling, temperature gage reading will increase due to reduced flow of coolant. This increased reading does not indicate true condition of cooling system or that any excessive temperature condition exists. Read gage as soon as vehicle is stopped and before above increase occurs; gage should not register above the "normal temperature" range (approximately 160°). Excessive heat always indicates trouble that may cause serious damage to the engine unless the cause is located and corrected.

2–4. Oil-pressure gage.—Indicator should remain in "normal range" section of dial when engine is at normal operating temperature. Lack of oil pressure may result in burned-out engine bearings or scored cylinder walls.

2–5. Viscometer.—Indicator should remain in the "normal range" section of dial with engine at normal operating temperature.

2–6. Ammeter.—If electrical load does not exceed generator output, ammeter should show a positive or zero charge at engine speeds faster than 12 to 15 miles per hour in direct drive. Ammeter needle should be steady while generator is charging. Zero or low charge reading when all lights and electrical accessories are turned off does not indicate any trouble but is usual when battery is fully charged. For the first few minutes after starting, ammeter will show high reading while generator restores to battery the current used in starting. High-charge reading for a long period may indicate a dangerously low battery or fault in generator or generator regulator.

2–7. Voltmeter.—While engine is running, voltmeter should register at least 6 volts.

2–8. Tachometer.—Report if indicating needle does not register. Red hand should not be in danger zone.

2–9. Air-brake pressure gage.—(If vehicle is equipped with air brakes.) Gage should usually indicate not more than approximately 105 pounds or less than approximately 85 pounds. (See maintenance manual.) Pressure should not drop excessively when brakes are applied. Report if pressure drops rapidly after engine is stopped.

2–10. Fuel gage.—Note approximate amount of fuel needed to fill tank as indicated by gage and after refueling tank (2–62), see whether gage is registering correctly.

2–11. Windshield wipers.—Operate. Report if arms or blades are missing or move too slowly, or do not move through their complete strokes.

2–12. Heater and defroster.—(If vehicle is so equipped.) Report if heater fan or defroster fan does not operate when needed, or if heater core or connections leak, or if electric defroster does not operate.

2–13. Engine.—If it vibrates excessively, report.

2–14. Fan belt.—Inspect for rubbing; looseness.

2–15. Ignition wires.—Inspect for sparking or bad insulation.

2–16. Carburetor.—Report if linkage is not connected and functioning properly.

2–17. Engine mounting bolts.—Check for looseness.

2–18. Carburetor controls.—Check for excessive play.

2–19. Fuel and oil lines.—Check for leaks.

2–20. Accessories.—Check for looseness.

2–21. Horn.—Try horn unless tactical situation prohibits. Repair or report.

2–22. Fire extinguisher.—Remove from bracket, shake and judge from sound and weight whether it is full. Be sure nozzle is clean of any obstructions such as mud or corrosion. When extinguisher is replaced, bracket should hold it firmly with handle in locked position. Every vehicle should have a filled fire extinguisher in good working order at all times.

Check mounting of CO_2 extinguishers for rigidness. Check for missing locking pin and for damaged or kinked hose. Fullness can be checked by weighing only.

2–23. Rear-view mirrors.—If a mirror is broken or lost, report. If loose in bracket, tighten. Adjust for best vision. Adjustment bracket on mirror should have sufficient drag to hold mirror in position.

2–24. Ammeter.—Should read zero with engine stopped and lights out.

2-25. *Voltmeter.*—Should read zero with engine stopped and lights out.

2-26. *Radiator.*—Remove cap (be careful of steam, especially if pressure cap is used), and replenish water if low. A heavy layer of oil on water in radiator may indicate leaking gaskets or cracked block or head. If this is present, check oil in crankcase for water, which would confirm the indication. Do not operate vehicle in this condition.

2-27. *Water leaks.*—If water in radiator was excessively low, examine for leaks in radiator, core, water pump, hose connections, or cylinder block and see whether oil level in crankcase has risen due to water leaking into crankcase. Drivers should not attempt to tighten water-pump packing nut if a leak occurs here, but should report. Overtightening of this packing nut may result in seizing of shaft and complete failure of pump. Report repeated low-water condition. It may indicate a clogged radiator or gas leakage through head gasket.

2-28. *Fan belt.*—Push against belt halfway between pulleys. It should deflect the amount specified in the maintenance manual, about ¾ inch (usually less for short belts). If it is too loose, it may cause loss of water and overheating of engine; generator may fail to run fast enough to charge battery, or may burn belt. If it is too tight, the extra load on generator or water-pump bearings may cause bearing failure and the belt may foul. Driver should adjust fan belt only in emergency. Ordinarily he should report for handling by the second echelon. If belt is frayed badly, it should be replaced.

2-29. *Engine oil.*—Remove bayonet oil level gage, dry with a clean cloth and then check level of oil. Add oil when necessary as recommended for the vehicle. If engine oil was excessively low, examine for leaks.

2-30. *Breather caps.*—If operating in sandy or dusty territory, remove oil-filler and valve-cover breather caps and clean, then dip caps in engine oil. Let excess oil drain off before replacing. It is extremely important that they be kept free of clogging.

2-31. *Air cleaner.*—Check oil level in cleaner bowl. Rub finger through oil to detect dirt. If bowl contains dirt, clean and refill with engine oil. See instructions marked on cleaner.

2-32. *Spark plugs, distributor, coil, and wiring.*—Look for oil leaks around spark plugs, which indicate loose plugs or unserviceable gaskets. High-tension wires should be attached to spark plugs, distributor and coil. Note any cracked, chafed, or broken insulation on wires. See whether radio shielding is clean, whole, and properly attached.

2-33. *Fuel leaks.*—Examine carburetor, fuel filter, fuel pump and connections for fuel leaks, which will waste fuel and create a fire hazard.

2-34. *Clean engine and accessories as required.*

2-35. *Steering mechanism.*—Look carefully beneath front end. Check to see whether steering-knuckle arms, tie rod, drag link and pitman arm are bent. Have relief driver turn steering wheel enough to right and left to take up all slack in steering mechanism; meanwhile observe any play in steering linkage or any looseness of pitman arm or of steering gear on frame. Report if steering stop screws are not intact. If these are damaged or lost, front wheels can be turned at too great an angle and the constant-velocity-type universal joints in the steering knuckles may fail. Feel steering-knuckle housings with bare hands. If too hot to hold hand on, steering knuckles may be damaged. Look for leaks of lubricant from steering-knuckle housings or from steering gear, which may indicate need to replenish lubricant or repair grease seals. Locating and correcting loose or damaged parts at this point may prevent an accident due to loss of vehicle control.

2-36. *Spare tire and carrier.*—See that carrier holds tire securely, that lock is in place, and that there are no damaged parts.

2-37. *Springs and suspensions.*—Examine springs for broken leaves, shifted leaves, loose or missing rebound clips, angle of spring shackles and position of spring. Springs with shifted leaves do not have their normal strength. Missing rebound clips may permit spring leaves to break on rebound or permit leaves to shift. Broken spring leaves may cause load to shift, make vehicle top heavy or hard to handle, or may even permit axle to shift out of line. Weak springs may break completely and lock the steering mechanism so that driver will lose steering control of the vehicle. Spring holddown U-bolts should be tight. Torque rods should not be loose or damaged.

2-38. *Brake lines.*—Brackets and springs should be tight and in place. Look for fluid leakage from the lines or connections.

2-39. *Air-brake reservoirs* (on vehicle with air brakes).—Open reservoir drain cock fully to draw condensation from reservoirs. When no water shows in escaping air, close drain cocks tightly. They should not leak when closed. If water is not drained, it will pass through entire air system.

2-40. *Driving axles* (wheeled vehicles).—Place hand on differential housings to determine whether they are unusually hot. Examine for lubricant leaks. When there are

any signs of leaks, remove lubricant level plugs to check lubricant level. Free breather of mud. Half-tracks—examine front-axle universal joints for torn or worn gaskets and for leaks; check oil levels.

2-41. *Transmission* (wheeled vehicles).—Place hand on transmission to determine whether transmission is unusually hot. Examine for lubricant leaks. When there are any signs of leaks, remove lubricant level plugs to check level of lubricant. Half-tracks—check oil levels.

2-42. *Transfer case* (wheeled vehicles).—Place hand on transfer case to determine whether transfer case is unusually hot. Examine for lubricant leaks. Transfer case normally operates at a temperature higher than the transmission. Even though it is too hot to touch with the hand longer than a few moments, trouble may not be indicated. Lubricant-level plug should be removed, however, under such conditions, to drain out any excess lubricant or be sure there is sufficient lubricant. Transfer case should never run so hot that radiated heat may be felt when hand is held close to the case. Clean breather if it is clogged with mud. Half-tracks—check oil level.

2-43. *Muffler tail pipe.*—Report if broken or damaged.

2-44. *Propeller shafts.*—Remove any foreign material found around shafts. Tighten loose universal joint bolts and look for bent shafts or missing parts.

2-45. *Clean and lubricate any parts that inspection indicates require it.*

2-46. *Tires.*—Remove all foreign matter such as nails, glass, or stones from tires or from between duals. Inspect tires for signs of abnormal tread wear, cuts, or wrong tread direction. On front wheels, the open end of the "V" of the tread design should touch the road first; on the rear wheels, the point of the "V" of the tread design should touch the road first. Replace missing valve caps.

NOTE.—Proper tire inflation is essential to the reduction of the high tire mortality rate and is one of the most vital problems of preventive maintenance confronting the Army. Most of the damage is due to underinflation, which causes uneven and rapid tread wear and damages the cords in the sidewalls of the tire due to the excessive flexing of the sidewalls. This excessive flexing also overheats the tires and weakens the casings so the tires may fail unexpectedly. Incorrect pressure also changes the rolling radius, which causes gear fight between those driving axles on which tire pressures are not all equal. Consequently, in addition to rapid tread wear, excessive strain is placed on the units of the driving system and premature failure may occur.

When should tire pressure be gaged? For tactical reasons, vehicles should be made ready to go, on a moment's notice, as soon as possible after operation. Also, more time is available then for checking tires and use of compressor equipment than during the other daily PMS's. Therefore, it is highly desirable to check and inflate tires *after operation*. But, when the tires are hot, accurate gaging is impossible; it takes as much as 4 hours for them to come back to atmospheric temperature. Before operation, the tires are cool and in ideal condition to be gaged and inflated to correct pressure; but the before-operation PMS is essentially a quick check and often time is not available for a thorough job. A practical solution to this problem is a detail to work on the tires of all the vehicles of the unit during the off-operation period, after the tires have had time to come back to equilibrium and in time enough before the resumption of the march to perform the necessary operations on all vehicles. If portable compressor equipment is available, it may be wheeled from vehicle to vehicle by the detail. Nonportable equipment may be placed upon a light vehicle and driven from place to place as required. Experience will soon dictate the size of the detail and time required for the service.

Whether or not the above procedure is used, it is still a function of the driver to examine the tires for cuts and foreign objects, to remove stones from between duals, and to detect and change flats or otherwise unserviceable tires. Flats can be detected on duals by hard kicking, by striking with a hammer, or by taking hold of the lash-rope hooks firmly and pressing the foot hard against the sidewall of the tire. These operations should always be performed by the driver as part of his after-operation, before-operation, and at-halt PMS's. If a detail is not assigned to work on the tires during the off-operation period, the gaging and inflation of tires should be performed as a part of the before-operation PMS (No. 3).

The air compressor of a vehicle equipped with air brakes can always be used to inflate tires. It should be used by the driver of the vehicle to inflate his own tires and, in an emergency, can be used to inflate the tires of other vehicles. The driver of an air-brake-equipped ve-

hicle will normally have time, even before operation, to check and inflate the tires of his own vehicle.

Check for improperly located or damaged valve stems.

So far as possible, tires of the same make and design should be used on wheels of same driving axle.

If dual tires must be changed, they should be properly matched. Tires with the greatest wear should be on the inside so load will be approximately the same on each dual tire when on crowned roads.

2–47. Hydraulic brakes (half-tracks).—Check pedal clearance. If braking action feels "spongy", bleed the braking system of air.

2–48. Lights and warning reflectors.—Inspect lights with switch at all positions. Check stop lights while brake pedal is applied. If lights flicker or fail to light, repair or report. During blackouts, inspect lights with switch in blackout position only. Be sure that switch is in "off" position after lights are inspected and that all lights are out. If lamps are loose, clean the ground connections and tighten. Report broken brackets and cracked lenses. Clean and inspect all lenses and warning reflectors.

2–49. Windshield.—Clean; report if broken. Tighten any loose parts. Clean windshield is especially important for night driving or at sunrise or sunset when a combination of glare and deep shadows is likely to impair visibility.

2–50. Wheel and axle-flange nuts.—Tighten any loose nuts on wheels and axle flanges. To be sure the inner duals are tight, loosen the outer nuts, tighten inner nuts, and tighten outer nuts again. Report any damaged wheels, rims or rim gutters, missing nuts and bolts, or grease leaks. After heavy pulling in low gear, the wheel nuts and axle flange nuts may work loose. This will occur also on new vehicles after ordinary operation. It will also occur on old vehicles after wheels have been changed. If loose flange nuts are not tightened, sufficient wear will occur to damage wheels, axles, or wheel hubs beyond further use.

2–51. Brake drums and wheel hubs.—Place hand on each brake drum and wheel hub. All brake drums should be approximately the same temperature. An excessively hot drum may indicate dragging shoes or improper adjustment. An abnormally cool drum may indicate brake on that wheel is not functioning. If wheel hubs are too hot to touch with the hand, bearings may be underlubricated, damaged, or improperly adjusted. A regular check of these factors will go far to avoid wrecks due to failure of the brakes at one or more wheels. It will also permit locating overheated bearings in wheel hubs before the bearings fail completely, so that adjustments or service may be rendered that will avoid a complete break-down of the vehicle.

2–52. Sheet metal.—See that hood, fenders, body panels, moldings, and other parts are not damaged, loose, or missing.

2–53. Power take-off and winch.—If cable is not tight and evenly wound, rewind it. Report if cable is kinked or strands are broken, as faulty cable may break and cause serious injury or death. Examine drive shaft and universal joints; nothing should be wound around it. See that extra shear pins are in tool box.

2–54. Bumpers, towing hooks, pintle, and safety chains.—Bumpers and towing hooks should be tight. Pintle hooks should lock, latch, should operate freely, and pintle should be tightly bolted on a frame. Be sure pintle latch is equipped with a lock pin. Inspect safety chains for any missing parts or damage.

2–55. Load, tarpaulin, and fastenings.—Inspect any cargo carefully for damage or shifting. All ropes should be lashed securely to hooks or ring. The load should be evenly distributed and complete. See that there are no loose pieces that may fall off during operation of vehicle. Place tarpaulin over load to protect against the elements. Be sure tarpaulin is tightly secured. Check for rips or holes in tarpaulin, missing or worn straps, grommets, or ropes. Check for damaged bows. Make similar inspection of towed load, if any.

2–56. Tractor fifth wheel and plate.—See that lower plate, coupler pin, locking jaws, and guide are well lubricated before connecting to trailer. If it is covered with grit or sand, clean and relubricate. In wet weather, fifth-wheel plate should be lubricated at least once a day to insure free movement of fifth wheel and proper tracking of trailer. See that hand lever for king-pin lock operates easily and that lock closes completely. Inspect for any worn, loose, or damaged parts. Look for bent U-bolts or marks on frame that would indicate bed plate has shifted. Also inspect fastenings of upper plate to trailer and inspect upper plate for cracks or distortion.

2–57. Trailer lighting and brake connections.—Check for frayed or broken cables and damaged or missing attachment plugs. Listen for air leaks if brakes are air operated. Make sure that support springs hold lines in a way to prevent chafing.

2–58. Rollers, front (half-track).—Check springs for breakage; rollers for dents, breakage, and free rolling.

2–59. Tracks (half-tracks).—Check tension; check for loose, broken or bent guides; check for cuts and gouges.

2–60. Track suspensions (half-tracks).—Check for permanent set or breakage of volute springs; clean off dirt, sticks, or wire that may have become wedged in upper roller and bogie wheels; check rear idler post for breakage or bending; check for loose nuts.

2–61. Sprockets (half-tracks).—Check for tightness of mountings and for worn or broken teeth.

2–62. Refuel tank.—When refueling tank, contact filler hose nozzle to tank before removing cap and keep the hose nozzle in contact with the neck while filling. Otherwise, a spark from static electricity may cause fire or explosion. Do not fill tank entirely to top of filler neck but leave space for expansion that takes place when the fuel warms up. Filler cap vent must be open (or pressure-cap valves must be free in case a pressure cap is used). Replace cap securely.

2–63. Tools, traction devices, and other equipment.—All tools assigned, including Pioneer tool equipment, tire chains, maintenance manual, parts list, and other special equipment belonging to the vehicle, should be with it and all tools should be clean and in good condition. If chains or traction devices have been used, clean and inspect for badly worn, broken, or missing links or damaged fastenings. Repair and oil them so that they will be ready for use again.

2–64. Grousers (half-tracks).—Check track grousers for breakage and worn or cracked sections.

95. Before-operation schedule (PMS No. 3)—Importance and general nature.—Distribute mimeographed copies of the before-operation schedule (PMS No. 3) *after* you have commented generally concerning its importance and nature. (See fig. 13.) In your statements, cover the following points: Many things can happen to a vehicle between the after-operation PMS and the time the vehicle rolls again. Sabotage may be attempted; another vehicle may back into it; tires may go flat; moisture may ground the spark plugs; engine oil, fuel, or water may leak out.

The before-operation PMS should never be entirely omitted, even in extreme tactical situations. If thoroughly trained in this schedule, the driver will go through it almost automatically so that but a few moments' time will enable him to size up the condition of the vehicle. He should report results of his inspection promptly to the chief of section or other designated individual.

Permit students to look through the schedule for a few minutes, and indicate that questions will be answered after it has been demonstrated.

PREVENTIVE MAINTENANCE SCHEDULE - WHEELED AND HALF-TRACK MOTOR VEHICLES

BEFORE OPERATION

FIRST ECHELON (FOR TRAINING PURPOSES ONLY)

PURPOSE: TO ASCERTAIN WHETHER CONDITIONS HAVE CHANGED SINCE LAST PMS #2

LEGEND: √ for "Satisfactory" 0 for "Not Satisfactory."

EXTERIOR - BEFORE STARTING ENGINE		3-10. Load, tarpaulin, and fastenings	
3-1. Vehicle in general		3-11. Tractor fifth wheel and plate	
3-2. Radiator		3-12. Trailer lighting and brake connections	
3-3. Engine oil		3-13. Tools, traction devices and other equipment	
3-4. Fuel		**UNDER VEHICLE**	
IN CAB - STARTING ENGINE		3-14. Tires	
3-5. Starter		3-15. Steering	
3-6. Instrument panel, horn, and windshield wiper		3-16. Tracks	
3-7. Fire extinguisher		3-17. Track suspension	
EXTERIOR		3-18. Sprocket	
3-8. Lights		**IN CAB - ENGINE WARMED UP**	
3-9. Windshield		3-19. Engine	

REPORT RESULTS PROMPTLY TO CHIEF OF SECTION OR OTHER DESIGNATED INDIVIDUAL.

REMARKS:

Vehicle (U.S.A. Registration No.)_____

Mileage_____

Date_____

Signed _____
Driver

5-20-42

FIGURE 13.—Preventive maintenance schedule No. 3.

NOTES

WHY PREVENTIVE MAINTENANCE IS NECESSARY BEFORE OPERATION

Many things can happen to a vehicle between the after-operation PMS and the time the vehicle rolls again. Sabotage may be attempted; another vehicle may back into it; tires may go flat; moisture may ground the spark plugs; engine oil, fuel, or water may leak out.

The before-operation PMS should never be entirely omitted, even in extreme tactical situations. If thoroughly trained in this schedule, the driver will go through it almost automatically so that but a few moments' time will enable him to size up the condition of the vehicle. He should report results of his inspection promptly to the chief of section or other designated individual.

DESCRIPTION OF PREVENTIVE MAINTENANCE SCHEDULE No. 3

3–1. Vehicle in general.—Look on ground under vehicle for leaks of oil, water, or fuel. Look for any injury to vehicle, and for any signs of tampering with it or with load and load fastenings. Tarpaulin should be firmly fastened and undisturbed. Raise hood and look for signs of any tampering or sabotage. Dry the spark plug porcelains with a cloth if they appear wet so engine will start more readily.

3–2. Radiator.—Water should be at correct level as left after operation. A heavy layer of oil on water in radiator may indicate leaking gaskets or cracked block or head. If this is present, check oil in crankcase for water which would confirm the indication. Do not operate vehicle in this condition. If water in radiator was excessively low, examine for leaks in radiator, core, water pump, hose connections, or cylinder block and see whether oil level in crankcase has risen due to water leaking into crankcase. Drivers should not attempt to tighten water-pump packing nut if a leak occurs here, but should report. Overtightening of this packing nut may result in seizing of shaft and complete failure of pump. Report repeated low-water condition. It may indicate a clogged radiator or gas leakage through head gasket.

3–3. Engine oil.—Should be at correct level as left after operation. If engine oil is excessively low, examine for leaks.

3–4. Fuel.—Should be at correct level as left after operation. If not at correct level, examine carburetor, fuel filter, fuel pump, and connections for fuel leaks. When refueling tank, contact filler hose nozzle to tank before removing cap and keep the hose nozzle in contact with the neck while filling. Otherwise, a spark from static electricity may cause fire or explosion. Do not fill tank entirely to top of filler neck but leave space for expansion that takes place when the fuel warms up. Filler-cap vent must be open (or pressure-cap valves must be free in case a pressure cap is used). Replace cap securely.

3–5. Starter.—When starting engine, report any unusual noise, failure of starter to crank engine, or too low cranking speed. After engine has started, let it run at a fast enough speed to run smoothly. This will warm up the engine so oil will be warmed enough to circulate to all parts of the engine. Do not race engine while it is cold. While engine is warming up, proceed with the steps below.

3–6. Instrument panel, horn, and windshield wiper.—Inspect instruments to see whether any new defects have developed since performing PMS No. 2. Be sure hand choke control, hand throttle, and foot throttle all operate freely. Check to see whether windshield wiper operates. Try horn unless tactical situation prohibits. Report any faults in above items.

3–7. Fire extinguisher.—Should be full and in good working order, as left after operation. Be sure nozzle is clear of any obstructions such as mud or corrosion.

3–8. Lights.—Should be same as left after operation. Inspect lights with switch at all positions. Check stop lights while brake pedal is applied. If lights flicker or fail to light, repair or report. During blackouts inspect lights with switch in blackout position only. Be sure that switch is in "off" position after lights are inspected and that all lights are out. Clean and inspect all lenses and warning reflectors.

3–9. Windshield.—Should be clean, tight, and unbroken.

3–10. Load, tarpaulin, and fastenings.—Should be same as left after operation. All ropes should be lashed securely to hooks or rings. Load should be evenly distributed. Inspect cargo carefully for damage or shifting.

3–11. Tractor fifth wheel and plate.—Should be same as left after operation. If it is covered with grit or sand, clean and relubricate. In wet weather, fifth-wheel plate should be lubricated at least once a day to insure free movement of fifth wheel and proper tracking of trailer. See that hand lever for king-pin lock operates easily and that lock closes completely. Inspect for any worn, loose, or damaged parts. Look for bent U-bolts or marks on frame that would indicate bed plate has shifted. Also inspect fastenings of upper plate to trailer and inspect upper plate for cracks or distortion.

3–12. Trailer lighting and brake connections.—Should be same as left after operation. Check for frayed or broken cables and damaged or missing attachment plugs. Listen for air leaks if brakes are air-operated. Make sure that support springs hold lines in a way to prevent chafing.

3–13. Tools, traction devices, and other equipment.—Should be same as left after operation. Also be sure any additional tools

or equipment needed for the job to be done are obtained before starting out.

3-14. Tires.—Check for flats. Remove all foreign matter, such as nails, glass or stones from tires or from between duals. Inspect tires for signs of abnormal tread wear, cuts, or wrong tread direction. On front wheels the open end of the "V" of the tread design should touch the road first; on the rear wheels the point of the "V" of the tread design should touch the road first. Replace missing valve caps. If a detail was not assigned to work on the tires during the off-operation period, the gaging and inflation of the tires should be performed now as a part of PMS No. 3.

3-15. Steering.—Inspect steering gear and linkage.

3-16. Tracks (half-track).—Examine for tension, cut or gouged sections.

3-17. Track suspension (half-track).—Examine for breakage, foreign material, lodged in upper roller bogie wheels, sprocket, and rear idler.

3-18. Sprocket (half-track).—Examine for worn teeth and for tightness of mounting.

3-19. Engine.—Accelerate engine slightly several times after it has reached normal operating temperature, and note any unusual noises which would indicate trouble. If engine has not yet reached normal temperature as indicated by the temperature gage, normal operating temperature may be assumed when the engine will idle with the choke fully released, when the oil pressure gage indicates reasonably close to normal operating pressure and *the viscometer* (if vehicle is so equipped) *reads in the normal range.* The normal warm-up period will vary; in cold weather it can be shortened by covering the radiator. When warming engine, do not run it faster that just enough to keep it running smoothly. Do not race the engine while warming it up.

96. During-operation schedule (PMS No. 4)—Importance and general nature.—Distribute mimeographed copies of the during-operation schedule (PMS No. 4) after you have commented generally concerning its importance and nature. (See fig. 14.) In your statements, cover the following points: In preventive maintenance it is important to notice unusual noises or odors, or slight peculiarities in vehicle performance, and to take correct steps before the deficiencies develop to the point of actual break-down. While the vehicle is in motion, a good driver listens for any sounds which may be signs of trouble, such as rattles, knocks, squeals, or hums. He looks for steam from the radiator or smoke from any part of the vehicle. He knows and watches for the odor of an overheated generator, overheated brakes, boiling antifreeze, fuel vapor from a leak in the fuel system, exhaust gas, or other such signs of trouble. Every time he uses the brakes, shifts gears, or makes a turn, he considers it a test and notes any unsatisfactory or unusual performance. A good driver constantly checks the instruments and notices promptly if any instrument indicates that some unit may be operating improperly. Permit students to look through the schedule for a few minutes, and indicate that questions will be answered after it has been demonstrated.

PREVENTIVE MAINTENANCE SCHEDULE - WHEELED AND HALF-TRACK MOTOR VEHICLES

DURING OPERATION

FIRST ECHELON (FOR TRAINING PURPOSES ONLY)

PURPOSE: To detect improper performance.

LEGEND: √ for "Satisfactory" O for "Not Satisfactory."

GENERAL			
4-1. Unusual sounds		4-4. Brakes	
4-2. Instruments		4-5. Clutch	
4-3. Steering		4-6. Transmission and transfer case	
		4-7. Performance	

REMARKS:

Vehicle (U.S.A. Registration No.)_____

Mileage_____

Date_____

Signed _____
Driver

5-1-42

FIGURE 14.—Preventive maintenance schedule No. 4.

NOTES

WHY PREVENTIVE MAINTENANCE IS NECESSARY DURING OPERATION

In preventive maintenance it is important to notice unusual noises or odors, or slight peculiarities in vehicle performance, and to take correct steps before the deficiencies develop to the point of actual break-down.

While the vehicle is in motion, a good driver listens for any sounds which may be a sign of trouble such as rattles, knocks, squeals, or hums. He looks for steam from the radiator or smoke from any part of the vehicle. He knows and watches for the odor of an overheated generator, overheated brakes, boiling antifreeeze, fuel vapor from a leak in the fuel system, exhaust gas, or other such signs of trouble. Every time he uses the brakes, shifts gears, or makes a turn, he considers it a test and notes any unsatisfactory or unusual performance. A good driver constantly checks the instruments and notices promptly if any instrument indicates that some unit may be operating improperly.

DESCRIPTION OF PREVENTIVE MAINTENANCE SCHEDULE NO. 4

4–1. Unusual sounds.—Listen for such noises as the following which usually indicate the trouble specified:

(*a*) *Squealing in engine.*—Generator or water-pump trouble.

(*b*) *Loud knocking in engine.*—Loose or burned-out connecting-rod bearing, broken piston, or broken-off valve head. Stop engine at once.

(*c*) *Dull, heavy thumping in engine.*—Loose or burned-out main bearing. Stop engine at once.

(*d*) *Light clicking in engine.*—Sticking valve; broken valve spring; loose wrist pin; piston slap; improperly spaced valves.

(*e*) *Spark ping.*—Fairly constant ping when engine is pulling may indicate need to remove carbon from engine combustion chambers, early ignition timing, or too wide a breaker point setting. If this noise develops rapidly, it may indicate that engine is overheating. Very slight spark ping during acceleration is not a sign of trouble.

(*f*) *Hissing.*—Escape of steam due to overheating; leak in vacuum connections from intake manifold; leak in air-pressure system on units equipped with air brakes.

(*g*) *Grinding noise under floorboard.*—Transmission, power take-off, or transfer-case trouble. Stop vehicle at once.

(*h*) *Heavy vibrations beneath vehicle.*—Loose or bent propeller shaft. Stop vehicle at once.

(*i*) *Squealing of tires on turns.*—Underinflation, overload, or excessive speed.

(*j*) *Axle hum.*—Improperly adjusted or worn final drive gears.

(*k*) *Knocking in axle.*—Damaged gear teeth or bearings. Stop vehicle at once.

4–2. Instruments.—Inspect instruments to see whether any new defects have developed since performing PMS No. 3. Also observe speedometer.

4–3. Steering.—Check for excessive pulling to either side if not due to crown of road. Also check for wandering of vehicle. This may be caused by loss of pressure in a tire. Check for excessive play in steering mechanism and for front-wheel shimmy which indicates excessive wear, loose parts or improper adjustments. If wheel tramp occurs, it may be due to excessive accumulation of mud on wheels.

4–4. Brakes.—If brakes do not operate smoothly and effectively, report at earliest opportunity. Failure of brakes to hold vehicle may result from excessive expansion of brake drums (caused by overheating); burned, wet, or greasy brake linings; or damage or leakage or air in hydraulic system. Brake pedal should have approximately ½ to 1 inch free travel. Otherwise, brakes will not release but will drag and overheat. Brake pedal should not go closer to the floor board than 2 inches when applied. Brake adjustment is necessary if pedal goes closer to the floor. Sluggish acceleration may be due to dragging brakes. Check to make sure that hand brake is entirely released.

4–5. Clutch.—Clutch should not chatter, squeal, or slip when fully engaged. Clutch-release-bearing damage is indicated if bearing makes a noise when clutch pedal is depressed. Clutch pedal should have enough (approximately 1 inch) free travel before it begins to disengage clutch. (See specifications for the vehicle for exact amount.) With too little free travel, clutch may slip; with too much, clutch may not disengage fully, causing gears to clash and damaging gear teeth.

4–6. Transmission and transfer case.—Gears should shift smoothly and should not slip or hop out of engagement during operation. Double clutching is necessary when shifting to avoid clashing teeth and damaging gears. Use of lowest gear in transmission to start a loaded truck rolling is necessary to get best life out of transmission gears. Unusual gear noise may indicate approaching failure which will completely wreck transmission if operation of vehicle is continued.

4–7. Performance.—Be on the alert; if faulty performance occurs, check for loose spark plug wires, wet spark plugs or distributor, high engine temperature, loss of oil or water. (Replenish water in a hot engine with engine running at a fast idle.) If cause is not readily found, report.

97. At-halt schedule (PMS No. 5)—Importance and general nature.—Distribute mimeographed copies of the at-halt schedule (PMS No. 5) *after* you have commented generally concerning its importance and nature. (See fig. 15.) In your statements, cover the following points: Some troubles are difficult to discover while rolling; therefore, advantage should be taken of every halt to locate and correct anything that may cause a fall-out after the march is resumed. During halts, the driver also has an opportunity to correct or report any condition noticed during operation but which was not serious enough to require action at the time. Results of the inspection at halt should be reported promptly to the chief of section or other designated individual. Permit students to look through the schedule for a few minutes, and indicate that questions will be answered after it has been demonstrated.

PREVENTIVE MAINTENANCE SCHEDULE – WHEELED AND HALF-TRACK MOTOR VEHICLES

AT HALT

FIRST ECHELON (FOR TRAINING PURPOSES ONLY)

PURPOSE: TO DETECT AND CORRECT DEFICIENCIES DEVELOPED DURING OPERATION.

LEGEND: √ for "Satisfactory" 0 for "Not Satisfactory."

IN CAB		5-9. Driving axles	
5-1. Hand brakes		5-10. Transmission	
		5-11. Transfer case	
EXTERIOR - FRONT, RIGHT SIDE, REAR, AND LEFT SIDE		5-12. Rollers	
5-2. Windshield		5-13. Tracks	
5-3. Brake drums and wheel hubs		5-14. Track suspensions	
5-4. Load, tarpaulin, and fastenings		5-15. Sprockets	
		UNDER HOOD	
5-5. Trailer lighting and brake connections		5-16. Radiator	
		5-17. Water leaks	
UNDER VEHICLE		5-18. Fan belt	
5-6. Steering mechanism		5-19. Engine oil	
5-7. Tires		EXTERIOR - FINAL	
5-8. Springs and suspensions		5-20. Refuel tank	

REPORT RESULTS PROMPTLY TO CHIEF OF SECTION OR OTHER DESIGNATED INDIVIDUAL.

REMARKS:

Vehicle (U.S.A. Registration No.)_____

Mileage_____

Date_____

Signed _____
Driver

5-20-42

FIGURE 15.—Preventive maintenance schedule No. 5

NOTES

WHY PREVENTIVE MAINTENANCE IS NECESSARY AT EACH HALT

Some troubles are difficult to discover while rolling; therefore, advantage should be taken of every halt to locate and correct anything that may cause a fall-out after the march is resumed. During halts, the driver also has an opportunity to correct or report

any condition noticed during operation but which was not serious enough to require action at the time. Results of the inspection at halt should be reported promptly to the chief of section or other designated individual.

DESCRIPTION OF PREVENTIVE MAINTENANCE SCHEDULE NO. 5

5–1. Hand brakes.—Hand brake lever ratchet should keep lever in applied position and brakes should hold.

5–2. Windshield.—Clean; report if broken. Tighten any loose parts. Clean windshield is especially important for night driving or at sunrise or sunset when a combination of glare and deep shadows is likely to impair visibility.

5–3. Brake drums and wheel hubs.—Place hand on each brake drum and wheel hub. All brake drums should be at approximately the same temperature. An excessively hot drum may indicate dragging shoes or improper adjustment. An abnormally cool drum may indicate brake on that wheel is not functioning. If wheel hubs are too hot to touch with the hand, bearings may be underlubricated, damaged, or improperly adjusted. A regular check of these factors will go far to avoid wrecks due to failure of the brakes at one or more wheels. It will also permit locating overheated bearings in wheel hubs before the bearings fail completely, so that adjustments or service may be rendered that will avoid a complete break-down of the vehicle.

5–4. Load, tarpaulin, and fastenings.—Inspect any cargo carefully for damage or shifting. All ropes should be lashed securely to hooks or ring. The load should be evenly distributed and complete. See that there are no loose pieces that may fall off during operation of vehicle. Place tarpaulin over load to protect against the elements. Be sure tarpaulin is tightly secured. Check for rips or holes in tarpaulin, missing or worn straps, grommets, or ropes. Check for damaged bows. Make similar inspection of towed load, if any.

5–5. Trailer lighting and brake connections.—Check for frayed or broken cables and damaged or missing attachment plugs. Listen for air leaks if brakes are air-operated. Make sure that support springs hold lines in a way to prevent chafing.

5–6. Steering mechanism.—Look carefully beneath front end. Check to see whether steering-knuckle arms, tie rod, drag link and pitman arm are bent. Have relief driver turn steering wheel enough to right and left to take up all slack in steering mechanism; meanwhile observe any play in steering linkage or any looseness of pitman arm or of steering gear on frame. Report if steering stop screws are not intact. If these are damaged or lost, front wheels can be turned at too great an angle and the constant-velocity-type universal points in the steering knuckles may fail. Feel steering-knuckle housings with bare hands. If too hot to hold hand on, steering knuckles may be damaged. Look for leaks of lubricant from steering-knuckle housings or from steering gear, which may indicate need to replenish lubricant or repair grease seals. Locating and correcting loose or damaged parts at this point may prevent an accident due to loss of vehicle control.

5–7. Tires.—Remove all foreign matter, such as nails, glass, or stones, from tires or from between duals. Inspect tires for signs of abnormal tread wear, cuts, or wrong tread direction. On front wheels the open end of the "V" of the tread design should touch the road first; on the rear wheels the point of the "V" of the tread design should touch the road first. If dual tires must be changed, they should be properly matched. Tires with the greatest wear should be on the inside so loads will be approximately the same on each dual tire when on crowded roads. So far as possible, tires of the same make and design should be used on wheels of same driving axle. Flats can be detected on duals by hard kicking, by striking with a hammer, or by taking hold of the lash-rope hooks firmly and pressing the foot hard against the sidewall of the tire. Replace any missing valve caps. Check for improperly located or damaged valve stems.

5–8. Springs and suspensions.—Examine springs for broken leaves, shifted leaves, loose or missing rebound clips, angle of spring shackles and position of spring. Springs with shifted leaves do not have their normal strength. Missing rebound clips may permit spring leaves to break on rebound or permit leaves to shift. Broken spring leaves may cause load to shift, make vehicle top heavy or hard to handle, or may even permit axle to shift out of line. Weak springs may break completely and lock the steering mechanism so that driver will lose steering control of the vehicle. Spring hold-down U-bolts should be tight. Torque rods should not be loose or damaged.

5–9. Driving axles (wheeled vehicles).—Place hand on differential housings to determine whether they are unusually hot. Examine for lubricant leaks. When there are any signs of leaks, remove lubricant level plugs to check lubricant level. Free breather of mud. Half-tracks—examine front-axle universal joints for torn or worn gaskets and for leaks; check oil levels.

5-10. Transmission (wheeled vehicles).—Place hand on transmission to determine whether transmission is unusually hot. Examine for lubricant leaks. When there are any signs of leaks, remove lubricant level plugs to check level of lubricant. Half-tracks—check oil level.

5-11. Transfer case (wheeled vehicles).—Place hand on transfer case to determine whether transfer case is unusually hot. Examine for lubricant leaks. Transfer case normally operates at a temperature higher than the transmission. Even though it is too hot to touch with hand longer than a few moments, trouble may not be indicated. Lubricant-level plug should be removed, however, under such conditions, to drain out any excess lubricant or be sure there is sufficient lubricant. Transfer case should never run so hot that radiated heat may be felt when hand is held close to the case. Clean breather if it is clogged with mud. Half-tracks—check oil level.

5-12. Rollers (half-track).—Check springs for breakage; rollers for dents, breakage, and free rolling.

5-13. Tracks (half-track).—Check tension; check for loose, broken or bent guides; check for cuts and gouges.

5-14. Track suspensions (half-track).—Check for permanent set or breakage of volute springs; clean off dirt, sticks, or wire that may have become wedged in upper roller and bogie wheels; check rear idler post for breakage or bending; check for loose nuts.

5-15. Sprockets (half-track).—Check for tightness of mountings and for worn or broken teeth.

5-16. Radiator.—Remove cap (be careful of steam, especially if pressure cap is used), and replenish water if low. A heavy layer of oil on water in radiator may indicate leaking gaskets or cracked block or head. If this is present, check oil in crankcase for water, which would confirm the indication. Do not operate a vehicle in this condition.

5-17. Water leaks.—If water in radiator was excessively low, examine for leaks in radiator, core, water pump, hose connections, or cylinder block and see whether oil level in crankcase has risen due to water leaking into crankcase. Drivers should not attempt to tighten water-pump packing nut if a leak occurs here, but should report. Overtightening of this packing nut may result in seizing of shaft and complete failure of pump. Report repeated low-water condition. It may indicate a clogged radiator or gas leakage through head gasket.

5-18. Fan belt.—Push against belt halfway between pulleys. It should deflect the amount specified in the maintenance manual, about ¾ inch (usually less for short belts). If it is too loose, it may cause loss of water and overheating of engine; generator may fail to run fast enough to charge battery, or may burn belt. If it is too tight, the extra load on generator or water-pump bearings may cause bearing failure and the belt may foul. Driver should adjust fan belt only in emergency. Ordinarily he should report for handling by the second echelon. If belt is frayed badly, it should be replaced.

5-19. Engine oil.—Remove bayonet oil level gage, dry with a clean cloth, and then check level of oil. Add oil when necessary as recommended for the vehicle. If engine oil was excessively low, examine for leaks.

5-20. Refuel tank.—When refueling tank, contact filler hose nozzle to tank before removing cap, and keep the hose nozzle in contact with the neck while filling. Otherwise, a spark from static electricity may cause a fire or explosion. Do not fill tank entirely to top of filler neck but leave space for expansion that takes place when the fuel warms up. Filler-cap vent must be open (or pressure-cap valves must be free in case a pressure cap is used). Replace cap securely.

98. Weekly schedule (PMS No. 6)—Importance and general nature.—Distribute copies of the weekly schedule (PMS No. 6) *after* you have commented generally concerning its importance and nature. (See fig. 16.) In your statements, cover the following points: Weekly preventive maintenance is a general tightening and check of certain factors that may affect vehicle performance. It also covers items that affect appearance but which are not likely to prevent vehicles from operating. Permit students to look through the schedule for a few minutes and indicate that questions will be answered after it has been demonstrated.

99. Demonstration and explanation of schedules.—Limit your instruction to *one schedule at a time*, following as closely as feasible the procedures outlined below: The general procedure in instructing the students concerning their duties as defined in a given schedule will be to assemble the students and assistant instructors in groups around a number of vehicles (less than 10 students to a vehicle would be a desirable ratio). The instructor then performs the various operations on a vehicle which is visible to the entire group. It would be ideal to have one assistant instructor for each vehicle. If this is not possible, use as many assistant instructors as are available. As the instructor performs a particular operation listed on one of the schedules, each assistant instructor should demonstrate this operation to his group of students and at the same time make all necessary explanations. In his explanation he should be concerned primarily with the nomenclature, location, function, and servicing of each part. An alternative procedure and one that is preferable when the assistant instructors have only limited training is for the instructor not only to demonstrate the various duties, but also to give explanations over a loud-speaker system while the assistant instructors merely duplicate his performance.

100. Student checking of schedules.—As the demonstration and explanation proceed, students should be instructed to refer to the particular schedules involved and to check, in accordance with directions, each schedule item as it applies to the vehicle around which they are grouped. The assistant instructors should then go through the checked schedules, point out any errors in checking and answer all questions concerning points not clear to the students.

101. Student practice of schedules before any driving practice.—The next step would be to have the students themselves practice under supervision the various duties in each schedule until they can show reasonable familiarity with the various duties. The assistant instructor should note and correct any errors that may be manifested during this process. The different schedules should be practiced at separate sessions, perhaps two meetings being devoted to PMS No. 2 (after-operation check) because of its comprehensiveness.

PREVENTIVE MAINTENANCE SCHEDULE - WHEELED AND HALF-TRACK MOTOR VEHICLES

WEEKLY

FIRST ECHELON (FOR TRAINING PURPOSES ONLY)

PURPOSE: TO TIGHTEN THE VEHICLE GENERALLY AND CHECK CERTAIN FACTORS THAT MAY AFFECT ITS PERFORMANCE. THIS SCHEDULE ALSO COVERS ITEMS THAT AFFECT APPEARANCE BUT WHICH ARE NOT LIKELY TO PREVENT VEHICLES FROM OPERATING.

LEGEND: ✓ for "Satisfactory" 0 for "Not Satisfactory"

IN CAB		6-16. Shock absorbers	
6-1. Cab floor		6-17. Transfer case bolts to frame	
6-2. Cab interior		6-18. Power take-off bolts	
6-3. Upholstery		6-19. Differential housing bolts	
6-4. Clutch-pedal free travel		6-20. Muffler and tail pipe	
6-5. Body hoist		6-21. Brakes	
EXTERIOR		6-22. Roller	
6-6. Body		6-23. Tracks	
6-7. Fenders and support bracket bolts		6-24. Track suspensions	
6-8. Bumpers, towing hooks, pintle, and safety chains		6-25. Sprockets	
6-9. Brush guards		6-26. Winch	
6-10. Tags and brackets		6-27. Battery	
6-11. Tractor fifth wheel and plate		UNDER HOOD	
6-12. Door latches and handles		6-28. Wires	
6-13. Door hinges		6-29. Fuel filter	
6-14. Door glass regulators		6-30. Clean engine	
UNDER VEHICLE		EXTERIOR - FINAL	
6-15. Steering knuckles (front driving axles)		6-31. Check lubrication	
		6-32. General tightening	
		6-33. Clean vehicle	
		6-34. Tires	

REPORT RESULTS PROMPTLY TO CHIEF OF SECTION OR OTHER DESIGNATED INDIVIDUAL.

REMARKS:

Vehicle (U.S.A. Registration No.)_____

Mileage_____

Date_____

Signed_____

Driver

5-27-42

FIGURE 16.—Preventive maintenance schedule No. 6.

NOTES

WHY WEEKLY PREVENTIVE MAINTENANCE IS NECESSARY

Weekly preventive maintenance is a general tightening and check of certain factors that may affect vehicle performance. It also covers items that affect appearance but which are not likely to prevent vehicles from operating.

DESCRIPTION OF PREVENTIVE MAINTENANCE SCHEDULE NO. 6

6–1. Cab floor.—Clean. Report if floor boards are broken.

6–2. Cab interior.—Report if cab lining is damaged or door panels are loose, or map compartment door does not operate properly. All screws and bolts should be tight. See that interior of compartment is clean and that nonmilitary material or literature is removed.

6–3. Upholstery.—Report if upholstery is torn or worn excessively or springs project through seat covers.

6–4. Clutch-pedal free travel.—Report if clutch pedal does not have correct free travel. Clutch pedal should have enough (approximately 1 inch) free travel before it begins to disengage clutch. (See specifications for the vehicle for the exact amount.) With too little free travel, clutch may slip; with too much, clutch may not disengage fully, causing gears to clash and damaging gear teeth.

6–5. Body hoist.—Raise body if vehicle is equipped with a body hoist. Listen for unusual noises in crossheads, hoist cylinder, pump, or power take-off. Report any leaks from the body hoisting mechanism which might permit the cylinder to run dry.

6–6. Body.—Report if hood is damaged and see that holding devices and brackets are tight. A loose latch may permit hood to fly open during operation and block driver's vision. Lettering should be legibile. Check for damaged or missing tail-gate chains, locking devices, safety straps, and molding. Examine for broken welds, loose or sheared rivets.

6–7. Fenders and support-bracket bolts.—Report if fenders are dented or broken and see that they are tightly bolted to brackets. Jagged edges on fenders may cause injury to anyone accidentally coming in contact with them.

6–8. Bumpers, towing hooks, pintle, and safety chains.—Bumpers and towing hooks should be tight. Pintle hooks should lock, latch should operate freely, and pintle should be tightly bolted on frame. Be sure pintle latch is equipped with a lock pin. Inspect safety chains for any missing parts or damage.

6–9. Brush guards.—Tighten all loose mounting bolts and replace any missing bolts.

6–10. Tags and brackets.—Clean all tags. Straighten bent tags or brackets, tighten any loose bolts, and replace missing bolts.

6–11. Tractor, fifth wheel and plate.—See that lower plate, coupler pin, locking jaws and guide are well lubricated before connecting to trailer. If it is covered with grit and sand, clean and relubricate. In wet weather, fifth-wheel plate should be lubricated at least once a day to insure free movement of fifth wheel and proper tracking of trailer. See that hand lever for king-pin lock operates easily and that lock closes completely. Inspect for any worn, loose, or damaged parts. Look for bent U-bolts or marks on frame that would indicate bed plate has shifted. Also inspect fastenings of upper plate to trailer and inspect upper plate for cracks or distortion.

6–12. Door latches and handles.—See whether any parts are damaged or missing and that the latches and latch striker plates hold doors securely closed. Doors should be checked for proper fit and easy closing and opening. Notice whether dovetails are in place. Tighten any loose screws or fastenings. Check straps should be in good condition.

6–13. Door hinges.—Tighten any loose screws or bolts and replace any that are missing.

6–14. Door-glass regulators.—Be sure all door glass can be raised and lowered properly and that no parts are damaged or missing.

6–15. Steering knuckles (front-driving axles).—Look for leaks of lubricant from steering-knuckle housings which may indicate need to replenish lubricant or to repair grease seals.

6–16. Shock absorbers.—Tighten arms, linkage, and shock-absorber-to-frame bolts if necessary. Report leakage of fluid from absorbers. If shock absorbers fail to function properly, springs may break because their rebound is not controlled.

6–17. Transfer-case bolts to frame.—Be sure bolts holding transfer case to frame are tight. If not, they may become so loose that transfer case might be pulled from frame under severe operating conditions.

6–18. Power take-off bolts.—Check for tightness.

6–19. Differential housing bolts.—Check for tightness.

6–20. Muffler and tail pipe.—Check for damage or looseness.

6–21. Brakes.—Check for loose parts and for chafed or loose connections.

6–22. Roller (half-track).—Check springs for breakage; rollers for dents, breakage, free rolling.

6–23. Tracks (half-track).—Check tension; check for loose, broken, or bent guides; check for cuts and gouges.

6–24. Track suspensions (half-track).—Check for permanent set or breakage of volute springs; clean off dirt, sticks, or wire that may have become wedged in upper roller and bogie wheels; check rear idler post for breakage or bending; check for loose nuts.

6–25. Sprockets (half-track).—Check for tightness of mountings and for worn or broken teeth.

6–26. Winch.—If cable is not tight and evenly wound, rewind it. Report if cable is kinked or strands are broken, as faulty cable may break and cause serious injury or death. Examine drive shaft and universal joints; nothing should be wound around it. See that extra shear pins are in tool box.

6–27. Battery.—Clean top of battery and terminals, using a brush or rag with water or a solution of water and baking soda if available. Dirt and water on top of battery permits leakage of current, causing corrosion at battery connections. Tighten terminal bolts, if loose. Remove battery caps and, if electrolyte is not well over top of plates, report so that distilled water may be added. If distilled water is not available, the use of any clean water is preferable to letting level of electrolyte get below top of plates. Battery case should show no signs of bulging, cracks, or leakage of electrolyte. Battery carrier should be clean, free from rust and well painted.

6–28. Wires.—Check for damaged insulation and loose connections. See whether radio shielding is clean, whole, and properly attached.

6–29. Fuel filter.—On vehicles with fuel tank above filter, close shutoff valve in fuel line. Remove drain plug so water and sediment will drain out of filter bowl. Then replace drain plug, tightening it securely, and reopen shut-off valve in fuel line. A common type of filter has only one plug in the bottom, which is the drain plug. On filter with two plugs in bottom of bowl, the plug to one side is the drain plug. If fuel filter is not found under the hood, consult the vehicle maintenance manual for its location.

6–30. Clean engine.—with a cloth, remove oil and dirt from engine and accessories. Clean spark-plug porcelains. An accumulation of oil, dirt, and moisture will cause shorting of plugs so that engine will be hard to start.

6–31. Check lubrication.—Remove lubricant-level plugs from all driving axles, and from transmission, transfer case, winch, steering gear, and steering knuckles; report, if lubricant is not at level specified for the vehicle. Check condition of all lubricant seals. Remove axle-housing and transfer-case breathers and blow through them to see whether they are clogged. Examine spring shackles, tie-rod and drag-link ends, and lubricate them if required.

6–32. General tightening.—Tighten axle housing and transmission and transfer case cap screws, and replace any nuts or cap screws that are missing. Tighten axle-flange and wheel nuts. Tighten muffler and tail pipe supports. Tighten pitman arm nut. Tighten steering-gear-to-frame bolts and steering-column-bracket bolts. Check tightness of all cab and body mounting bolts.

6–33. Clean vehicle.—Sweep out inside of cab. Clean all glass. When cleaning body, do not rub lusterless paint as it will become shiny and lose its camouflage value. If vehicle is washed in a creek, river, or lake, avoid getting water in transfer case or water and sand in brakes or other assemblies.

6–34. Tires.—Inflate tires to correct pressure, checking with a gage. Do not attempt to bring tires to correct pressure while they are hot. If tires are continually low, check valves for leaks and examine carefully for nails in tires.

The following technique may be employed to promote the students' interest and progress in their practice: From the group of students around each vehicle, one man should be picked at random and asked to check the vehicle for all the items on a given schedule, without referring to the schedule itself. The other members of the group, each with a copy of that schedule, should observe and, at the end of the test, inform the student of errors and omissions of his performance. Every member of the group would be asked in turn to go through the same test in a competitive spirit. To make possible the after-operation check by the students who have not yet learned to drive a military motor vehicle, the instructor or assistant instructor could operate the vehicle for a few minutes before student checking. In the case of the during-operation check, the students should be told to assume that the vehicle is in motion and to indicate what they would look for and do in that case.

102. Student practice of schedules during driving practice.—At the end of these practice sessions, it should be pointed out to the students that they will be required to go through all of these schedules throughout their actual driving practice so that they will have additional opportunity in this course to make these preventive maintenance habits stick.

103. General instruction concerning lubrication.—Emphasize the driver's responsibilities with respect to lubrication by talking directly to the students as follows: When everything is going well and you are in close touch with the second-echelon mechanics of your unit, the amount of lubrication which you, as a driver, must perform is limited. It is extremely probable, however, that occasions will arise in the field when the responsibility for lubricating your vehicle will fall entirely on your shoulders. That is why you should be present when your vehicle is being lubricated by second-echelon mechanics. That is also why you are expected to assist the mechanics in such lubrication. Thus, you will learn how to perform this important duty yourself if it becomes necessary. An improperly lubricated vehicle is sure to go out of action within a short time. Different makes and models of vehicles require different kinds of lubrication, and at different points. You have a maintenance manual for the vehicle to which you are assigned, and the details for proper lubrication of that vehicle are contained in that manual, being summarized in a special chart. You should study these details carefully.

E—TIRES AND WHEELS

104. General.—*a. Objective.*—To develop in student drivers the ability to remove and replace wheels and tires and to make minor repairs of tubes.

b. Place.—Shop.

c. Materials.—Sufficient number of vehicles so that all student drivers may obtain adequate practice in time available on sample rims, tire tools, hammer, patching set, 150-pound air source with chuck and gage, tire spreader.

d. Personnel.—If possible, one assistant instructor to each student driver.

e. Reference.—TM 31–200, Maintenance and Care of Pneumatic Tires and Rubber Treads.

105. Parts of tire assembly.—Assemble student drivers and assistant instructors in shop and point out on dismounted tires the major parts of the tire assembly as follows:

a. Casing.—A strong outer covering inclosing and protecting the tube.

b. Tube.—An airtight container which is inclosed and protected by the casing.

c. Rim.—A circular metal strip which completes that portion of the tube inclosure not covered by the casing, holds the casing in place, and connects the casing and tube assembly to the wheel.

106. Casing.—*a.* On a demonstration cutaway casing, point out the following main structural points (see fig. 17):

(1) *Plies.*—Layers of rubberized cords running diagonally across the casing.

(2) *Cords.*—In each ply these cords run at right angles to the cords in the next ply.

(3) *Beads.*—These are the wire hoops over which the plies are looped. The hoops keep the casing from stretching and prevent it from being forced off the rim as the vehicle is driven. Beads are of different shapes to fit different types of rims.

(4) *Breaker.*—A soft layer of cords between the tread and the plies.

(5) *Cushion.*—Two layers of soft rubber, one above and one below the breaker, which bind the breaker to the plies and to the tread.

(6) *Tread.*—Made of heavy rubber capable of sustaining considerable wear and usually finished on its outer surface with a grooved design to give greater gripping power or traction. The tread rubber extends all the way around the bead and waterproofs and protects the bead and plies.

b. Point out that while most people refer to the casing as the tire, a complete tire assembly includes the casing, tube, and rim. Mention that the internal plies and beads make up what is called the carcass of the casing.

107. Tube.—Display a tube and point out that the tube holds compressed air which serves as a cushion to absorb road shocks as the vehicle is operated. The tube is made of a single thickness of rubber and is not strong enough to withstand more than a few pounds of air pressure. However, when it is inclosed by the casing and the rim, it withstands pressures of from 30 to 95 or more pounds to the square inch, depending on the size and construction of the casing.

108. Valve.—The tube is fitted with a stem which passes through a hole in the rim. This valve core permits inflation of the tube to the desired pressure and keeps the air in.

109. Rim.—Using various types of rims for demonstration purposes, point out that the rim may either be a detachable unit or it may be permanently fastened to the wheel. If it is detachable, it is

usually fastened to the wheel with lugs. There are four types of rims in common use:

a. Drop-center rim.—This type of rim is usually permanently fastened to the wheel. It gets the name "drop-center" from a well around the middle of the rim. The beads on tires mounted on this type of rim must be slightly tapered to correspond in shape to the bead seats on the rim.

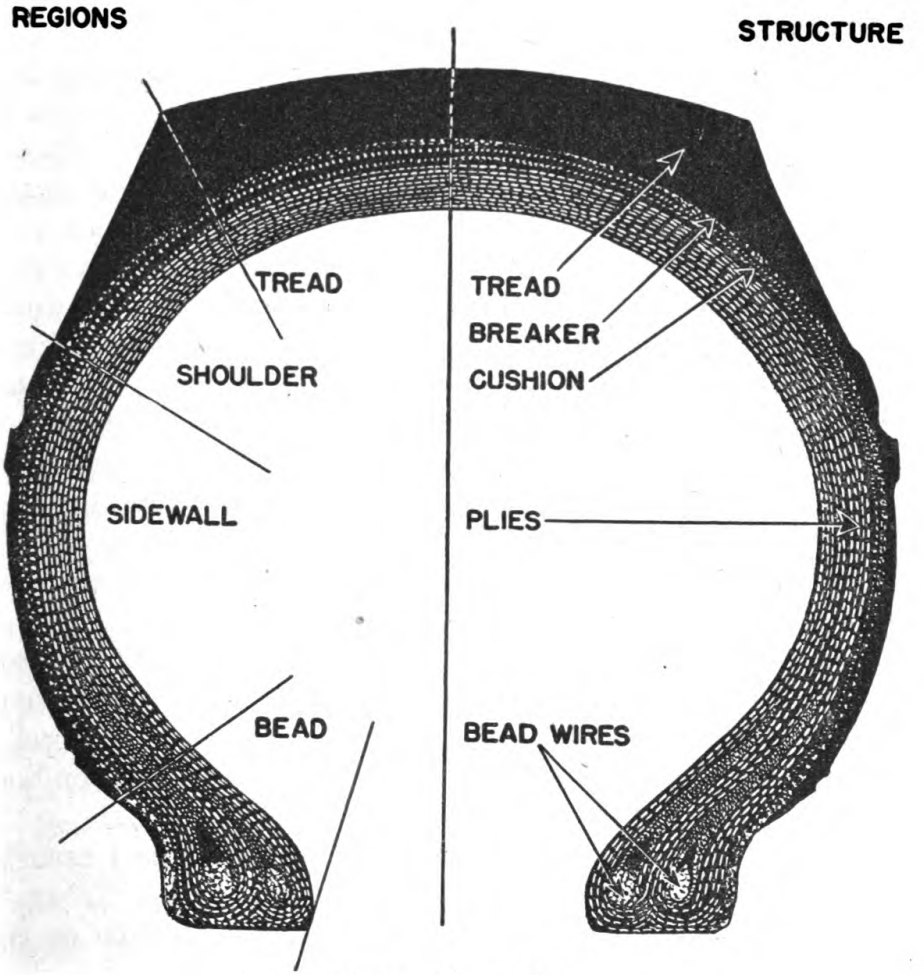


FIGURE 17.—Casing.

b. Semidrop-center rim.—In this type of rim, the well is not so deep as in the drop-center rim, one flange of which is removable. As the bead seats of this type of rim are also slightly tapered, the casing beads are tapered to correspond.

c. Flat-base rim.—This type of rim does not have tapered bead seats or a middle well; therefore, casings used with it must be flat at the beads.

d. Run-flat or combat rim.—This type of rim has a band in the center and one flange is bolted on to grip the beads and keep the tire from coming off, even when it is completely flat. Only run-flat casings are used with this type of rim.

110. Removing wheel.—Have assistant instructor demonstrate removing a wheel while you explain as follows:

a. Use of jack.—Put on hand brake. The vehicle must next be jacked up so that the casing will clear the ground. In jacking up a wheel on soft ground, it is necessary to build a base of blocks or other materials to provide firm support for the jack. When jacking up a wheel, always block the other wheels to prevent the vehicle from rolling; never depend on the brakes to hold the vehicle. Place the jack directly under the spring pad and jack up the vehicle until the wheel clears the ground. (When only an outside tire of a dual wheel is to be removed, the vehicle may be driven up on a block so that the outside wheel clears the ground.) Put blocks of wood or other material under the axle to hold the axle up in case the jack slips and falls. It is difficult to raise a vehicle that has fallen on the wheel drum since the jack can no longer be placed under the axle and the chassis is too high to permit use of the jack. In addition, serious personal injury as well as damage to the brake shield and drum may result if the jack should fall after the wheel is removed.

After you are sure the vehicle is securely jacked, release hand brake before dismounting tire. Remove the mounting nuts, plugs, or cap-screws. If the wheel and tire assembly is very heavy, it may be removed more easily if a greased board or a bar, such as the handle of the wheel wrench, is placed on the ground so that the wheel and tire assembly may be slid along this support. Do not stand on board; straddle it.

b. Left-hand thread.—On some vehicles the left wheel nuts have a left-hand thread. Generally the stud nut is stamped "L" or "R." To ascertain whether a nut that is not marked has a left- or right-hand thread, try to turn the nut alternately to the right and to the left with a wheel wrench, using increasing force until the nut loosens.

111. Dismounting tires.—Have assistant instructor demonstrate dismounting tires while you explain as follows:

a. Drop-center rim tires.—When dismounting tires mounted on drop-center rims—

(1) Remove valve cap and valve core, completely deflating the tube.

(2) Loosen both beads from the rim flanges.

(3) Insert two tire irons between the outer bead and the rim near the valve and about 6 inches apart.

(4) Kneel on the casing and pry outer bead over the flange while pushing lower part of the bead into the well with the knee.

(5) Leaving one tire iron as it is, go around the rim of the flange with the other, and remove remainder of the bead.

(6) Reach inside the casing and remove the tube starting opposite the valve and working outward.

(7) Open casing and lift out the valve.

(8) Let inner bead drop into the well, grip outer bead and pull it straight out until the casing swings free.

b. Semidrop-center rims.—When dismounting tires mounted on semidrop-center rim—

(1) Remove valve cap and valve core, completely deflating tube.

(2) Loosen outside bead by one of the following methods:

(*a*) Using two tire irons, one straight and one forked, insert flat end of straight tire iron between the bead and the rim, holding smooth side of iron next to the tire to avoid cutting the bead. Make sure the iron is inserted until it strikes the rim. While holding the straight iron in place, insert forked end of the other iron so that notches on the two irons will mesh. Draw handle of the forked iron down toward the tire, keeping the straight iron firmly against the side wall. This will break the bead loose.

(*b*) Using one tire iron and a hammer, insert tire iron between the side ring and the tire bead. Pry tire loose by forcing the iron toward the tread. If necessary, hold the iron against the side of the tire and hammer the iron just above the side ring with a medium-weight hammer.

(3) Remove the lock ring. In the case of a split ring, the bead must be forced away from the ring and the ring forced in toward the bead just far enough to unlock it. Next pry the ring out over rim flange with the tire iron entering into the breaking notch. To avoid twisting the ring, pry only enough to clear the rim flange. If necessary, follow around the rim flange with a second tire iron until the ring can be lifted off. In the case of a continuous ring, push side of casing opposite the square notch into the rim gutter. Continuously force side of casing at the notch over the edges of the ring. Insert tire iron in the square notch and pry out and up while holding the ring down at the opposite side. When pried up enough to clear the crescent notches, the ring can be lifted off. In the case of a two-piece ring, insert the tire iron in the notch and, holding the plain ring away, force the lock ring in and over the rim.

(4) Force portion of outside bead opposite the valve into the well. Insert tire iron under the bead, near the valve, then pry the bead up and over the bead seat, while holding the opposite side in the well. Proceed around the casing until the bead is off the rim.

(5) Remove the part of the flap and tube opposite the valve stem and push valve stem through the hole in the rim. Then reach in and lift the valve stem out. Never remove a tube by pulling on the valve stem, as this strains the tube and may cause it to leak.

(6) With the bead loose, force part of it into the well, stand the casing and wheel upright, and pry the wheel out of the casing.

c. Flat-base rims.—When dismounting tires mounted on flat-base rims, up to and including removal of the ring, follow same procedure as when dismounting semidrop-center rims. With the rim supported on blocks, loosen the other bead and pull rim straight out of the casing, unhooking the valve after the part of the rim opposite valve slot has been pulled clear. If there is no valve slot, push valve through the hole.

112. Repairing punctures.—Have assistant instructor demonstrate the cold and hot patch methods of repairing punctures, while you explain as follows:

a. Cold patch method.—In using the cold patch kit, clean an area ½ inch around the cut, puncture, or tear. Roughen this area with a scraper. Coat the area with rubber cement and allow cement to become tacky or sticky. Remove protective cloth from the patch, taking care not to touch the gummed surface, and press patch firmly on the cemented area. (Puncture-sealing or bulletproof tubes which are coated inside with soft spongy rubber can only be repaired with cold patches).

b. Hot patch method.—For applying a hot patch, clean area around the puncture. Remove protective covering from patch, being careful not to touch the rubber face with the fingers. Next clamp the patch to the tube and ignite the combustible material in the cup of the patch. When flames die out and patched area is sufficiently cool, remove the clamp and the metal cup.

113. Fitting tubes and flaps.—Have assistant instructor demonstrate mounting tires, while you explain as follows: In fitting all tubes and flaps, make sure the rim is free from dents and rust, and that the casing is free from cuts, dirt, glass, and metal particles. Remove any dust, dirt, or other particles from inside of casing. If the casing is cut or broken, do not use; report instead. Use a tube that is the correct size for the casing, because a tube that is too large will wrinkle and wear out quickly, while a tube that is too small will

stretch when it is inflated and will also wear out quickly. The flap is used to protect the tube on a flat-base or semiflat-base rim. It covers the part of the tube not covered by the casing and extends between the tube and the casing. Only a full-circle flap should be used and it should be the proper size for the casing. A flap that has been used in a wrinkled condition cannot be smoothed out satisfactorily and must be replaced. The flap must fit without wrinkles and must lie smoothly between the casing and the tube, for a wrinkle will quickly wear through the tube. Use the proper size of flap, as a flap that is too small is difficult to center and may not protect the tube, while a flap that is too large will wrinkle.

114. Directional treads.—Point to directional treads on correctly mounted tires and bring out the following: Directional tread casings must be mounted on *all* rear wheels so the point of the "V" meets the ground first when moving forward. In this position the tread is self-cleaning and provides maximum traction; if the casing is mounted so that the point of the "V" meets the ground last, mud tends to pack into the tread, forming a smooth surface with reduced traction. When mounting directional tread casings on wheels of front-driving or nondriving axles, the casing should be mounted so that the open part of the "V" meets the ground first. To summarize, on rear wheels directional tread casings should be mounted so the point of the "V" meets the ground first; on front wheels, they should be mounted so the point of the "V" meets the ground last.

115. Mounting casings.—Have assistant instructor demonstrate mounting casings on rims while you explain as follows:

a. Drop-center rims.—Mounting casings on drop-center rims—

(1) Inflate the tube until it begins to fill out. Then insert it in the casing, placing the valve at the balance mark.

(2) Apply part of the inside bead with the valve outside, but near the valve hole.

(3) Push inside bead down into the well and force remainder of the bead over the rim flange. (If necessary, use a hammer to top the last portion of the bead over the flange.)

(4) Spread casing and put valve stem through the hole in the rim.

(5) Place top part of outside bead in the well and drive on the rim with the hammer, working around the rim until the bead is in place. While driving the bead on the rim, keep as much of the bead in the well as possible.

(6) Lift outside bead with tire iron and put valve in position. Make sure that the valve is straight, sliding the casing around the rim if necessary. Center the casing around the rim.

(7) Inflate tube slowly until the beads of the casing are forced out tightly against the rim flanges. Make sure that the casing is centered. If the beads fail to seat properly against the rim flanges, either the tube is pinched under the bead, part of the bead is still in the well, or there is a dent in the rim.

(8) If any of the above conditions happen, completely deflate the tube and reinflate, allowing it to assume a proper position in the casing. The first inflation usually stretches the tube unevenly and the deflation and reinflation are necessary to allow the tube to stretch to a uniform thickness.

(9) Check valve for leaks by holding finger and rubbing saliva across the top of the valve stem. Put on the valve cap.

b. Semidrop-center rims.—Mounting casings on semidrop-center rims—

(1) With valve core in the stem, inflate tube until it begins to fill out.

(2) Insert the tube, then the flap. When inserting the flap, make sure the edges are tucked in evenly and smoothly all around the tire.

(3) When necessary, lubricate beads and rim with soapy water to aid installation. *Do not use oil as oil is destructive to rubber.*

(4) Place wheel, with rim flange down, on small blocks.

(5) Place tire on rim with valve stem in line with the valve hole in the rim. Insert valve stem through the hole.

(6) Place part of the inside bead near the valve stem into the well of the rim. Using a tire iron, pry remaining portion of the bead down over the rim. While doing this, work first on one side of the bead and then on the other so that the part of the bead opposite the valve stem will come on last. If necessary, tap lightly on the inside of the bead with a hammer to force the last part of the bead over the rim.

(7) To apply the outside bead, start at a point opposite the valve stem and press the bead into the shallow well of the rim. Pry remaining portion of the bead over the rim with a tire iron or tap it on with a hammer. Work the bead over a little at a time by taking small "bites." The blocks which hold the wheel off the ground make this operation easier.

(8) Apply the side ring by one of the following methods, depending on the type of ring used:

(*a*) *Split ring.*—Place end without notch in the gutter at a point opposite the valve stem. Hold this end and work around the ring, forcing it into the rim gutter.

(*b*) *Two-piece ring.*—Apply the plain ring, placing end of the split ring without the notch in the gutter of the rim, opposite the valve

stem. While holding this part in place, pry remainder of the ring in the rim gutter a little at a time. Snap notched end into place.

(*c*) *Continuous ring.*—Start the ring onto rim opposite the square notch, making sure that the two cut-out portions (crescent notches) rest on the sides of the wheel. Hold the first portion of the ring in gutter of the rim and pry the remaining portion over the wheel. To pry the last portion into place, insert the tire iron in the notch thus putting tension on the ring, and tap the ring with a hammer.

(9) Inflate tube slowly to not more than 10 pounds. Make sure that the side ring is properly seated in the rim gutter. (Tapping the ring lightly with a hammer will help seat it firmly.) Make sure that the tire beads rest evenly against the rim flanges all around the tire. Turn tire and wheel over with the ring down, or lean tire and ring against a wall with the ring side toward the wall, and inflate to the proper pressure. Be sure to use this procedure when inflating the tube as serious injuries and death have resulted in cases where the ring has blown off.

(10) Check valve assembly for leaks. Put on valve cap.

c. Flat-base rims.—Mounting casings on flat-base rims—

(1) With valve core in the stem, partly inflate the tube.

(2) Insert the tube, then the flap. When inserting the flap, make sure that the edges are tucked in evenly and smoothly all around the casing.

(3) Lubricate beads and rim with soapy water to aid installation. *Do not use oil.*

(4) Place wheel, with rim flange down, on three or four small blocks. Put valve stem in slot and lay the opposite side of the casing on the rim. Lift up valve side and let the casing drop on. (If there is no slot, lay the casing on the ground. Hold the rim over the casing and line up the valve with the hole. Push valve into the casing and lower rim into the casing. Turn casing and rim over.) Apply the ring in the same manner as when applying drop-center rims.

(5) Inflate in the same manner as when inflating casings mounted on semidrop-center rims, observing the same safety precautions.

116. Mounting wheels.—Have an assistant instructor demonstrate replacing wheel-tire assemblies while you explain as follows: Clean contacting surfaces of rim or wheel and hubs so that the wheel will run true. To replace wheels attached by studs or nuts, reverse order of removal. Always make sure that studs on dual wheels are tight before tightening the nuts. If the rim is mounted by means of lugs which fit on tapers, apply rim and spacer band, if used, and then push lugs on by hand, centering the rim on the wheel. After turning

nuts by hand until snug, tighten lug nuts, one turn at a time. Tighten first one nut and then the nut opposite it. Never tighten nuts in order around the rim. Let off brake and spin wheel to make certain that the wheel runs true.

NOTE.—You have now had assistant instructor demonstrate and you have explained methods of removing and installing wheels, dismounting and mounting tires, and patching tire leaks. Now assign student drivers and vehicles to assistant instructors and have student drivers practice all these procedures under the supervision of assistant instructors until proficient. In the course of this practice, have assistant instructors make sure that student drivers learn how to use tire gages correctly.

UNIT 4—TECHNIQUE OF DRIVING

A(1)—TYPES OF VEHICLES

117. General.—*a. Objective.*—To acquaint student drivers with various types of military vehicles and with the names and functions of controls and other devices with which they should be familiar for efficient driving.

b. Place.—Driving field; classroom.

c. Teaching aids.—Different types of vehicles.

d. Personnel.—See *f* below.

e. References.

TM 10–510, The Motor Vehicle.
FM 25–10, Motor Transport.
TM 10–1147, Maintenance Manual, GMC 2½-ton 6x6.
TM 10–460, Driver's Manual.

f. Note to instructors.—If there are enough men in the unit who know Army vehicle controls, gages, and safety devices, assign them as assistant instructors. Then have enough vehicles lined up so there is one for each five or six students. As the regular instructor points out the particular device or control in the cab, the assistant instructor should duplicate his performance explaining it to the five or six students grouped around the cab. If the assistant instructors have only limited training, the regular instructor should not only demonstrate the various duties, but also should give an explanation over a loud-speaker system while the assistant instructors merely follow his directions. Local circumstances may permit an alternative and equally effective procedure for instructing students concerning vehicle controls, gages, and safety devices. Some of these vehicle parts have already been covered in Unit 3. These can be reviewed and the remainder taken up in appropriate places in later sections of Unit 4.

Thus, the location and function of the clutch pedal could easily be learned (or if already known, learned further) in conjunction with demonstration and practice of the actual operation of the clutch pedal. If this were done, paragraphs 120 through 138 would be eliminated. The effectiveness of this procedure would depend on the preparation and ingenuity of the instructor.

118. Classification of vehicles by purpose.—Explain briefly to assembled students that military motor vehicles are divided into three groups based on the use for which they are designed and developed:

a. General purpose vehicles.—These are used for hauling general cargo, ammunition, personnel, and equipment as well as for towing trailers, guns, and other wheeled equipment. Examples: Cargo trucks, dump trucks, passenger vehicles.

b. Special purpose vehicles.—These are designed for technical duty, combat duty or special duty. Examples: Tanks, combat cars, wrecking trucks, fuel trucks, etc.

c. Plant vehicles.—These are designed for use at arsenals, proving grounds, airdromes, etc.

119. Specific types of vehicles.—Describe briefly the various types of military motor vehicles:

a. Ambulances.—Wheeled vehicles designed for transport of sick and wounded.

b. Armored cars.—Wheeled combat vehicles designed primarily for reconnaissance.

c. Carriers (cargo or personnel).—Full-track, half-track or convertible (track or wheel) combat vehicles designed for carrier use.

d. Combat cars and tanks.—Track-laying or convertible (track or wheel) armored combat vehicles.

e. Command cars.—Wheeled vehicles designed for use of commanders and staff of units in the field.

f. Motorcycles.—Wheeled vehicles designed or intended for messenger, reconnaissance, repair crews, or traffic control purposes.

g. Passenger cars.—Designed for transportation of personnel.

h. Semitrailers.—Wheeled vehicles without motive power, resting on and attached to the chassis of the truck-tractor by means of a fifth wheel arrangement.

i. Scout cars.—Wheeled armored combat vehicles designed primarily as personnel carriers or for reconnaissance.

j. Tractors.—Vehicles designed primarily for towing or combat service. They may be full- or half-track laying, convertible or wheeled.

k. Trailers.—Wheeled vehicles without motive power, but provided with suitable drawbars or tongues for attaching them to trucks or other towing vehicles.

l. Trucks.—Wheeled or track vehicles designed primarily for carrying cargo, equipment, or personnel.

m. Truck-tractors.—Wheeled vehicles, equipped with a fifth wheel arrangement, designed for towing semitrailers.

NOTE.—If possible, show to the students at this time Training Film 11–551 (reel I), which pictures some of the types of vehicles mentioned above, and also refers to the vehicle controls, gages, and safety devices in Unit 4A–2.

A (2)—NOMENCLATURE AND FUNCTION OF VEHICLE CONTROLS, GAGES, AND SAFETY DEVICES

120. General.—The objective, place, teaching aids, personnel, references, and note to instructors for this unit are the same as listed in paragraph 117. It is suggested that this unit be taught immediately after Unit 4A–1, except when the condition mentioned in paragraph 117*f* prevails.

121. Vehicle cab.—*a.* Start the instruction informally by asking—

(1) What is the name of the compartment in which the driver sits? (Cab.)

(2) What is the general term for levers and other devices by which the driver controls his vehicle? (Controls.)

(3) In what compartment are these controls? (Cab.)

b. Now draw attention to the actual cab. Show that the controls are arranged so that the driver can easily reach them. Explain that the cab is provided for the protection and comfort of the driver.

122. Position of driver.—Explain how good or poor driver position affects ability to use the controls and how they affect vision through the windshield. Show how the correct position makes it easier for the driver to reach and operate the controls and how it enables him to see better. Point out that by sitting correctly, the driver will not tire as quickly and he will be more alert.

123. Hand brake.—In order to bring out the name and function of the hand brake ask the following question: What is the most important precaution to keep vehicle from rolling downhill when it is parked? After question is answered, point out hand brake.

124. Transmission shift lever.—Ask the following questions: What lever regulates the position of the gears? In what position should this lever be before starting the engine? Why?

125. Shift arrangement plate.—Point to shift arrangement plate. Explain that this plate shows the driver the proper order in which the gears are used in shifting. Mention that drivers will find it convenient to refer to this plate when learning gear shifting. Add that drivers should check this plate whenever they get into a different kind of vehicle because the pattern for shifting gears varies somewhat with different types of vehicles.

126. Hand throttle.—Point out hand throttle and explain its function. (This is a button which controls the amount of gasoline reaching the cylinders and consequently controls the speed of the engine. Pulling it out causes the engine to run faster.)

127. Choke button.—Point out choke button and explain its function. (This is a button which, when pulled out, increases the proportion of gasoline in the gasoline-air mixture which goes to the cylinders. It is used in starting when the engine is cold and used only until the engine has warmed up.)

128. Clutch pedal.—Bring out the name and location of the clutch pedal by asking: What control on the floorboard should be pushed in before starting the engine? Why? (So as to disconnect the engine from the transmission as a safety feature; so as to reduce the load on the battery by not making it necessary for the starter motor also to turn over the transmission gears.)

129. Ignition switch key.—In order to bring out the name and function of the ignition switch and key, ask the following question, and lead class to proper answer: What is the first thing to do in order to start the engine?

130. Starter button.—Point to the starter button and explain that this starts an electric motor which "turns the engine over" until the engine "catches" and begins to run under its own power.

131. Accelerator.—Introduce the accelerator by use of leading questions, such as—

What control, other than the hand throttle, regulates the speed of the engine? Where is this control?

132. Road speed caution plate.—Point to road speed caution plates (fig. 19) and explain that this shows the highest safe speed at which the vehicle may be driven without danger of damage to any gear.

133. Governors.—Explain that most vehicles are equipped with governors to regulate maximum engine speed. Emphasize that under no circumstances should drivers tamper with the governor.

134. Brake pedal.—Ask someone to catch a piece of chalk that you will throw out to the class. Ask the person who catches it to come

up and point out the brake pedal and describe in his own words its function. Ask for comments. Clarify any points not previously covered.

135. Transfer case high and low range shift lever.—Explain the purpose of the transfer case high and low range shift lever. This is the proper name as given in TM 10–1147. (The transfer case high- and low range shift lever permits the driver to engage either one or the other of two sets of gears. In one of these sets of gears, a vehicle may be driven through all speeds with an extremely high ratio of power but with very low speed of motion. This is the "low" range. In the other ratio the vehicle may be driven in all gears at considerably higher speed of motion, but with proportionately less power. This is the "high" range, and this range is used for ordinary street and highway driving.)

136. Transfer case front axle declutching lever.—Explain the function of the transfer case front axle declutching lever. This is the proper name as given in TM 10–1147. (The transfer case front axle declutching lever is used to throw the front wheels in gear so that they will serve as driving wheels exactly as the rear wheels serve as driving wheels in normal driving. Then the front wheels are able to assist the rear wheels when the driving surface is very bad, such as sand or mud, etc. The front wheels can be used for driving when the transfer case shift lever is in either high or low range positions.) Ask class to explain the difference in function between the following shift levers:

Transmission gearshift lever.
Transfer case high and low range shift lever.
Front axle declutching lever.

Reclarify all points not clear. If any points are not clear, go over them again and explain.

137. Steering wheel.—In an informal way, point out that it is hardly necessary to describe the function of the steering wheel, and that whether the vehicle keeps on the road or is wrapped around a telegraph pole depends on how the steering wheel is used. Emphasize, however, that technique of steering is exceedingly important and not as simple as some people think. (Where to place one's hands on the wheel and how to turn corners by the hand-over-hand technique are matters that must be taken seriously.)

138. Vehicle gages.—Point out that you have now discussed all the controls used in actual operation of the vehicle. Add that vehicles are equipped with certain devices which warn the driver that some-

thing may be wrong. Explain briefly (as described in Unit 3B and D) the purpose and function of the following gages, having someone locate each one in the cab of a demonstration vehicle or on the cab diagram: ammeter, oil gage, temperature gage, fuel gage, and speedometer.

139. Safety devices.—Explain the difference between the gages (which warn the driver that something may be wrong with the mechanism of his vehicle) and the safety devices (which are aids to the safe operation of the vehicle). Have two or three students come up and point out in the cab or on the diagram as many safety devices as they can.

140. Miscellaneous aids to safety and operation.—Briefly explain and demonstrate the use of the following miscellaneous accessories:

a. Fire extinguishers.—Remove from bracket in cab and explain method of operating. Emphasize that the driver must be sure that fire extinguisher is on vehicle and full of chemical solution at all times. Explain that the driver can tell whether or not the fire extinguisher is full by lifting or shaking it.

b. Rear-view mirror.—Demonstrate how the rear-view mirror is adjustable to provide a clear view of the road.

c. Sun visors.—Demonstrate adjustment of sun visors.

d. Windshield wipers.—Explain that windshield wipers may be operated either by the vacuum in the intake manifold or by air pressure. Point out control button.

e. Defroster.—Point out that the defroster warms a section of the windshield in cold weather and prevents it from becoming covered with snow or sleet; also, that it prevents fogging the inside. Explain that defrosters are either electrically operated or operated by the heat from the engine. Point out control.

f. Fenders and bumpers, etc.—Point out all accessories attached to the frame and designed for the protection of the vehicle. Indicate how the fenders and bumpers are attached to the frame and mention the preventive maintenance services required to protect them from damage and to keep them secure (inspection and tightening).

g. Maintenance manuals and parts lists.—Show these to driver and explain that they are furnished with the vehicle and kept in a compartment in the instrument panel except when in use. Emphasize that, when in doubt concerning the manner of performing any preventive maintenance operation he is authorized to perform, the driver should consult these manuals.

B—FIRST STEPS IN DRIVING

141. General.—*a. Objective.*—To develop in student drivers the ability to start the engine, shift gears, steer, back, park, stop, and otherwise control the vehicle so as to operate it effectively and without abuse under simple driving conditions.

b. Place.—On driving range or field.

c. Equipment and facilities.—Sufficient number of vehicles to enable all students to get necessary amount of practice in available time. Driving field lay-out in accordance with figure 19. (Boundaries about which vehicles may maneuver should be set up by the use of stakes, lime, blocks 3 to 4 inches high, barrels, or other materials so that if struck by vehicle, they will cause no damage to it. In laying out driving range make sure that the lay-outs or rings are widely enough separated so that vehicles maneuvering on one driving range will not conflict with the movement of vehicles on other driving ranges. For dimensions of range, see par. 150.)

d. Materials.—One copy of Preventive Maintenance Schedule No. 3, given to each student driver before instruction commences. One copy of instructions for each assistant instructor. Have copies of material in paragraphs 146 through 157 prepared in advance by mimeographing or other means.

e. Personnel.—The ideal system for elementary driving instruction is to have for each vehicle an assistant instructor who has an Army motor vehicle operator's permit. However, that is not always possible. Some students are more experienced or apt than others. After some preliminary instruction, the instructor may be able to select outstanding students to act as assistant instructors under his supervision. On the type of driving range described, ten trucks may be operated simultaneously under the general supervision of the instructor. With three or four assistant instructors, the instructor should be able to direct effectively the learning of about 30 student drivers.

f. References.

FM 25-10, Motor Transport.
TM 10-1147, Maintenance Manual, GMC 2½-ton 6x6.
TM 10-460, Driver's Manual.

142. Introductory remarks.—Assemble student drivers and briefly explain that experience has shown that effective driving—the kind that gets there safely and on time—is dependent upon how well the first steps in driving skill are mastered. Point out that good driving habits are most easily formed if beginning drivers clearly understand that there is a best and most effective way to perform

each operation and the reasons why that way is best. Emphasize the importance of learning correct habits at the start to avoid necessity of changing faulty habits later.

143. Before-operation check.—*a.* Explain that although the vehicle was carefully inspected immediately after it was last operated, it is always necessary to check again before operation to make certain that nothing has gone wrong in the meantime. (For example, slow leaks may have developed, or someone may have backed into the vehicle, or it may have been damaged by sabotage.) Give a specific illustration.

b. Assemble the men around a vehicle. Select one assistant instructor and have him check all parts listed on the before-operation schedule (Preventive Maintenance Schedule No. 3).

c. At the same time, explain what faulty conditions the assistant instructor is looking for and what steps a driver would have to take in order to correct them if they were found.

d. Emphasize that if the driver finds any faulty condition which he has been told not to correct himself, that condition should be reported to his immediate superior.

e. Have assistant instructor check the following items in this order (see PMS No. 3, fig. 13):

(1) *Exterior—Before starting engine.*
- 3–1. Vehicle in general.
- 3–2. Radiator.
- 3–3. Engine oil.
- 3–4. Fuel.

(2) *In cab—Starting engine.*
- 3–5. Starter.
- 3–6. Instrument panel, horn, and windshield wiper.
- 3–7. Fire extinguisher.

(3) *Exterior.*
- 3–8. Lights.
- 3–9. Windshield.
- 3–10. Load, tarpaulin, and fastenings.
- 3–11. Tractor fifth wheel and plate.
- 3–12. Trailer lighting and brake connections.
- 3–13. Tools, traction devices, and other equipment.

(4) *Under vehicle.*
- 3–14. Tires.
- 3–15. Steering.

3–16. Tracks.
3–17. Track suspension.
3–18. Sprocket.

(5) *In cab—Engine warmed up.*

3–19. Engine.

f. As the check by the assistant instructor is being made, explain that exterior items are being checked before engine is started and items in cab are being checked while starting engine, etc., as noted on PMS No. 3.

NOTE.—To promote from the first the development of preventive maintenance as a habit, you should require every student driver to go through Preventive Maintenance Schedule No. 3 at least once each day. As soon as practicable, Preventive Maintenance Schedule No. 4, Preventive Maintenance Schedule No. 5, and Preventive Maintenance Schedule No. 2 should be introduced so that the student will practice preventive maintenance from the earliest stages of driving. (See Unit 3D.)

144. Signals.—Before actual driving commences, explain and demonstrate the signals to be used by instructors on the driving range to direct movements. A descriptive illustration of the following signals appears in Unit 4E(2) (fig. 31):

Attention.
Mount.
Start engines.
Forward march.
Decrease speed.
Stop engines.
Dismount.

Instruct drivers to signal when they are ready to start. (This may be done by extending left arm horizontally while sitting behind the wheel.)

145. Starting and warming engine.—Now have the assistant instructor get into the cab and perform the operations of starting and warming up the engine. While the assistant instructor is demonstrating, you should describe each operation the driver has to perform, step by step, as follows:

a. Make sure the hand-brake lever is pulled back. (If it is not pulled back, pull it back.)

b. With left foot, push clutch pedal down as far as it will go and hold it there.

c. Make sure transmission gear-shift lever is in neutral position. (If it is not in neutral position, put it there.)

d. Pull out hand throttle about ½ inch, if necessary to get engine started.

e. Pull choke button about halfway out when starting in cold weather.

f. Insert ignition key in ignition switch lock and turn to "on" position.

g. Step on starter button and take foot off as soon as engine starts.

h. When engine is started, release clutch pedal.

i. As engine warms up, push choke button in gradually until it is in all the way.

j. After engine is idling properly, push hand throttle in all the way.

NOTE.—The following procedure may be employed in provisional truck company areas before going onto driving range.

146. Vehicle check-starting engine.—Have student drivers go to vehicles and properly perform the before-operation preventive maintenance check (PMS No. 3), items 3–1 to 3–4, inclusive. Have student drivers mount vehicles from right and sit behind the wheel. Explain why vehicles are mounted from right and emphasize the importance of so doing. Have them go through the operations of starting and warming up the engine, as just demonstrated. Have them repeat starting engines as many times as required, until they can start engines correctly and without any instructions, prompting, or other assistance. With engines running slowly and smoothly, have student drivers properly perform the before-operation preventive maintenance check (PMS No. 3), items 3–5 through 3–19, inclusive. Have student drivers shut off engines by turning ignition switch to "off" position.

147. Transmission gear shifting with vehicle motionless.—*a.* Assemble men around a few vehicles and have assistant instructors get into the cabs to show the various positions of the gearshift lever by demonstration. (Be sure that assistant instructors mount vehicles from the right and that they do not put vehicles in motion at this time.)

b. Explain the action of engaging and disengaging the clutch and the use of the accelerator when shifting gears by pointing out the following:

(1) That the gears should never be shifted until after the clutch pedal has been pushed down all the way.

(2) That shifting gears should be done rapidly and smoothly.

(3) That the clutch and the accelerator are operated at the same time, and that the clutch is pushed down as the accelerator is let

up, and also that the accelerator is pushed down as the clutch is let up. (Explain the "friction point" in letting up the clutch.)

c. Now point out the transmission and transfer case shift arrangement plate (fig. 18) and explain that it is for the guidance of the driver in learning the various positions of the gearshift levers.

d. Before demonstrating the shifting of gears, make sure that the winch lever is in the proper neutral position, then start engine and place the transfer-case shift lever in neutral position. While going through the gear range, explain the following:

(1) *First gear.*—In this gear the vehicle has the maximum pulling power which can be obtained without the use of front-wheel drive.

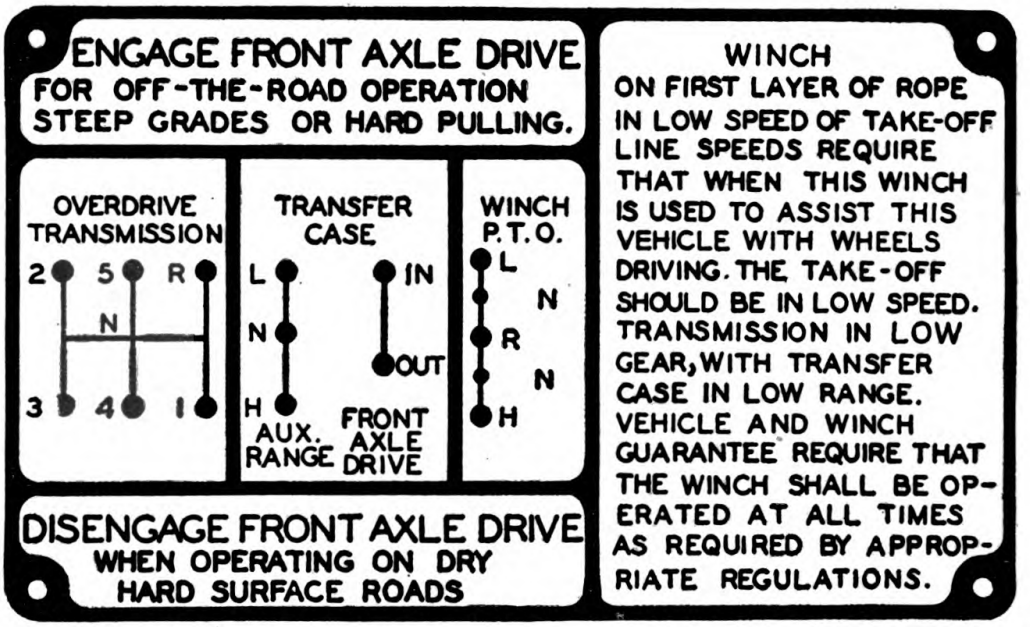


FIGURE 18.—Transmission, transfer case, and power take-off shifting arrangement plate.

(2) *Second gear.*—This gear provides almost as much pulling power as first gear. Vehicles will nearly always be started in this gear except when driving over difficult terrain or up steep grades.

(3) *Third gear.*—This gear provides a moderate amount of power while moving the vehicle at reasonable speed.

(4) *Fourth gear.*—This is the gear generally used under favorable road conditions.

(5) *Fifth gear.*—In this gear, the vehicle will move at maximum speed but with very little pulling power for operation on hills, in mud, or in sand.

(6) *Reverse gear.*—This gear moves the vehicle backward.

148. Double clutching.—It is important that student drivers learn double clutching from the beginning. Have it explained and

demonstrated thoroughly at this time. It may be necessary to review it from time to time by giving individual attention to those student drivers who experience difficulty in learning double clutching. (See fig. 19.)

a. Point out that the purpose of double clutching is to synchronize the speed of the flywheel and the turning clutch disks so that gear shifting may be accomplished with a minimum of clashing of gears. Explain the process of double clutching when shifting to a lower speed as follows:

(1) Depress clutch pedal.

(2) Move gearshift lever to neutral position.

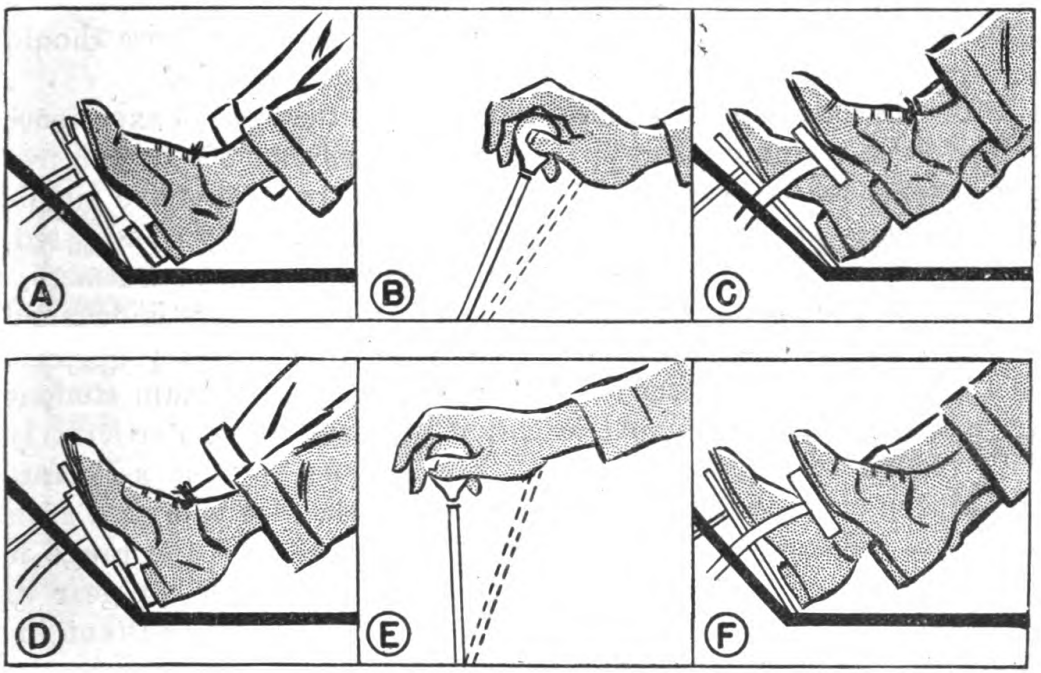


FIGURE 19.—How to double-clutch.

To shift into a lower gear when running in high—(A) declutch, (B) put gears into neutral, (C) engage clutch and simultaneously speed up engine for an instant, (D) declutch, (E) shift gears, and (F) engage clutch again with simultaneous increase in engine speed to very nearly maximum.

(3) Release clutch and at the same time depress the accelerator until the engine speeds up and the gear speeds are more nearly synchronized.

(4) Depress clutch pedal again and move gear-shift lever to the next lower position.

(5) Release clutch pedal and at the same time accelerate engine to obtain desired road speed.

b. Explain that the procedure is the same for shifting to a higher speed, except that the engine is not accelerated while the gears are in neutral.

149. Transmission gear shifting with vehicle in motion.—At this point you are ready to have student drivers begin actual driving practice. Progress will depend largely on the amount of driving experience the men have had in civilian life. It is recommended that to begin with, if possible, you divide the men into two groups. Segregate the inexperienced men from the more advanced. The latter group may then be sent to the driving range to begin actual practice (if there is sufficient instructional personnel). Carry out the following procedure with the inexperienced: assistant instructors should drive vehicles, shifting up and down the gear range while student drivers observe. Work out the best system you can by rotating men so that all will have a chance to observe this demonstration in a minimum of time. After this demonstration, actual practice should be carried out on the driving range by all student drivers.

150. Dimensions of driving range.—On the basis of experience gained from training Army drivers, a driving range 300 by 160 feet is recommended. (See fig. 20.) Ten trucks may be operated simultaneously on a range of this size. These dimensions may be adjusted, however, in proportion to the number of trucks in use at one time.

151. Procedure on driving range.—This procedure is outlined in figure 20. The length of time spent practicing each step depends on the ability and driving experience of the men. Certain student drivers may need individual attention now and then, particularly with regard to double clutching. You or one of your assistants should step on the running board to help out the men who need such assistance. As student drivers begin to drive around the range it will be necessary for you to indicate from time to time the gear in which you want them to drive. This may be done by assistant instructors or assistants posted to signal the drivers by holding up the number of fingers corresponding to the gear in which they should drive. Be sure to rotate the men so that each man will be given the necessary amount of time behind the wheel. There should be a driver and an assistant driver in each vehicle to be used, and the rest of the men should either ride in the back of the vehicle or stand in the center of the driving range to observe. As soon as vehicles are in proper place on the driving range, assemble the men and explain the system which will be followed.

152. Initial maneuvers.—*a. Mounting.*—Review the signals that will be given to direct the movements of the student drivers. Now give signal to mount. (Be sure that all student drivers mount from the right side.)

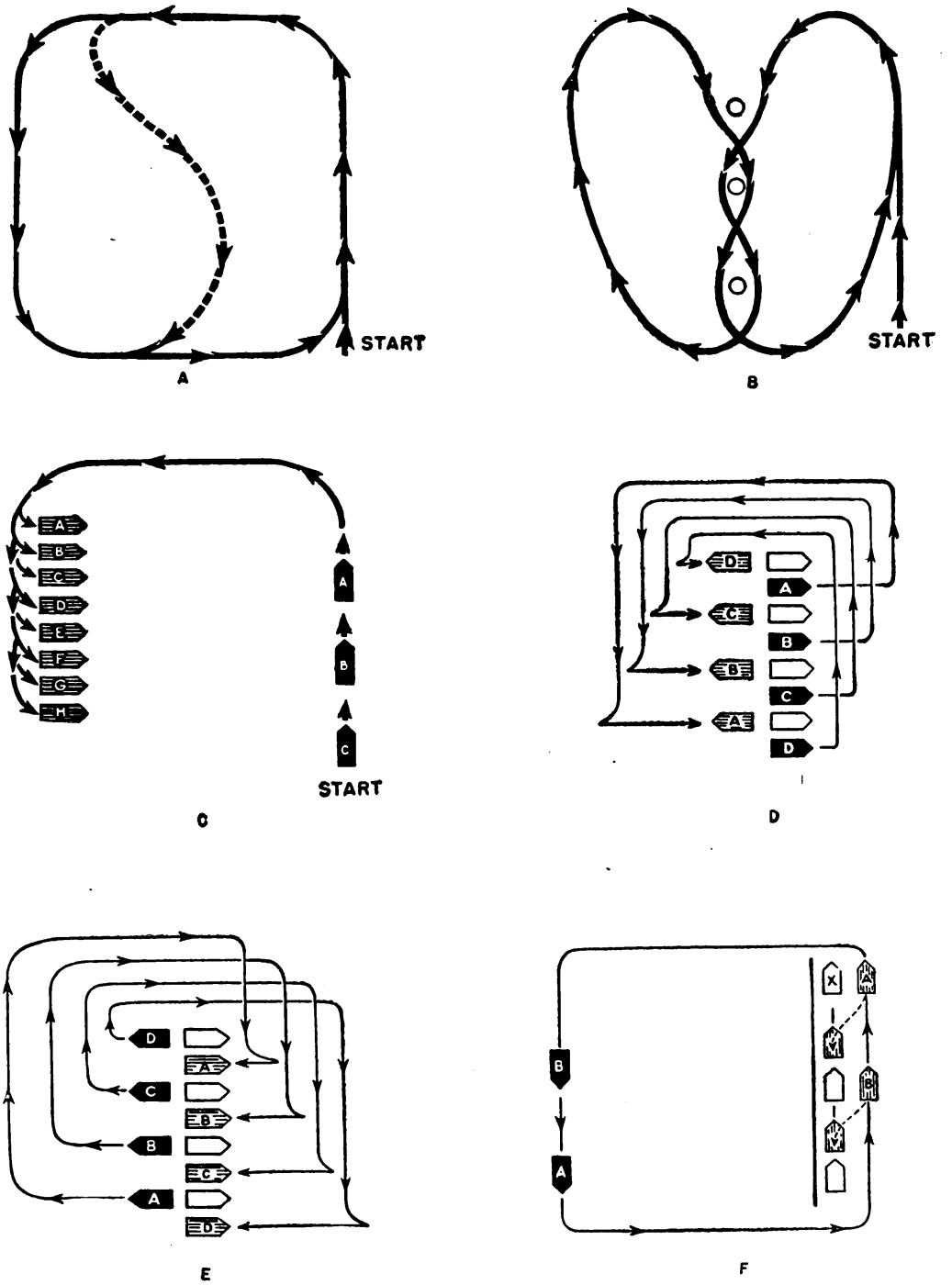


FIGURE 20.—Diagrams showing driving range lay-outs and movements of vehicles.

b. Starting engine.—When all student drivers are properly seated behind the wheel, give signal to start engines.

c. Forward march.—When all student drivers have started engines, checked to see that everything is in order and signalled that they are ready to start, give the signal "forward march." (A recommended system for drivers indicating that they are ready, is for them to signal by extending the left arm from the cab horizontally. If you have not previously instructed them in this technique, do so now.) Have assistant instructors, or assistants who are posted around the driving range, hold up one finger, indicating that student drivers are to move ahead in first gear. Have vehicles move around the range once or twice until student drivers have acquired the feel of first gear. (See fig. 20A.)

At this point, stop all vehicles to see if any student drivers have any questions. Follow this procedure adding the higher gears up to and including the fourth gear and also going down the gear range in reverse order.

NOTE.—From the very beginning all vehicles should move at a slow speed. The speed should be increased gradually and up to the minimum limit necessary for shifting into higher gears. Before having student drivers shift down to lower gears, it may be necessary to halt all vehicles and give another explanation of double clutching.

Do not forget to give every driver a chance.

After a sufficient amount of time has been spent driving around the range in this direction, instruct student drivers to cut diagonally across the driving range (as shown by dotted line in fig. 20A) and drive in the opposite direction. This will give them practice in making right turns.

153. Figure 8 driving.—Blocks, barrels, or other obstacles are arranged so as to increase the skill necessary for driving in and around them. A space of 42 feet is suggested to start. This may gradually be decreased to 30 feet. (See fig. 20B.) Have student drivers practice this maneuver until they are proficient. Give signal to dismount.

154. Parking in alinement.—*a.* Assemble men and explain that the next steps have three objectives:

(1) To develop in student drivers the ability to back and park vehicles in proximity to other vehicles or to a loading platform.

(2) To develop in student drivers the ability to park in a confined space, such as a box stall.

b. Point out that the desired parking arrangement may be marked off on the ground. Have student drivers practice parking in alinement with other vehicles as shown in figure 20C.

155. Backing to platform.—With vehicles in alinement, as shown in figure 20C, explain to student drivers that the next step will be for alternate vehicles (A, B, C, D, fig. 20C) to perform the following maneuver. Drive ahead, circle to the left, pass around the left end of the line of vehicles which remain, and back so that the rear of each vehicle will be opposite the tail gate of the stationary vehicles as shown in figure 20D.

156. Backing into stall box.—After this maneuver is performed, have vehicles A, B, C, and D reverse the above procedure by driving ahead, turning right, and backing into the vacant spaces, as shown in figure 20E, until they resume their previous places in line (shaded figures). Next the vehicles which were previously stationary go through the maneuvers shown in figures 20D and 20E. These maneuvers will be practiced until all drivers have become proficient in them.

157. Parking parallel to curb.—With at least three vehicles parked in a straight line, as shown in figure 20F and with a distance between those vehicles equal to the length of a vehicle plus 6 to 10 feet, the drivers practice parking parallel to the curb as follows: The student driver in vehicle A (fig. 20F) maneuvers his vehicle close beside and parallel to vehicle X, cuts the front wheels sharply to the left, then backs up. When it approaches an angle of 45° to vehicle X, he cuts the front wheels sharply to the right and backs his vehicle into position, as shown by shaded figure. He repeats backing into a parking space and driving out again until he can do so with little difficulty. (Drivers should become proficient in parking their vehicles in a reasonable space, close to the curb, and directly behind the vehicle ahead. They should learn to do so quickly and with ease.)

158. Operating in low range (transfer case).—Assemble student drivers, vehicles, and assistant instructors and briefly remind drivers that military motor vehicles are equipped with a transfer case which is a tremendously powerful low-gear arrangement and a mechanism for supplying traction or pulling power to the front wheels, primarily for cross-country operations.

a. Use of low range.—These mechanisms are controlled by levers in the cab which are connected by rods to the transfer case. They are used when extreme power or traction is needed. Front-axle drive should not be engaged when operating on dry, hard-surfaced roads. Ask student drivers under what circumstances, in their opinion, such

extremes of power and traction would be required (climbing steep slopes, crossing ditches and shell holes, driving in deep mud or sand, hauling heavy loads or towing other vehicles cross-country, etc.). Point out that instruction in the use of the lower gear ratios will be given now, in order that when the time comes for students to practice driving under such extremely difficult conditions, they will be familiar with all the controls.

b. Shifting into low range.—Have an assistant instructor get into a vehicle and refer to the steps necessary to engage the front-axle drive and shift into the low speed range, as follows:

(1) The clutch pedal is pushed down, releasing clutch.

(2) The front axle declutching lever is moved forward to the "in" position (point out that the front-axle drive must always first be engaged before shifting into "low" range). An interlocking device on the front-axle declutching lever prevents error in shifting.

(3) Then the high and low range shifting lever is moved forward to the "low" range position. Emphasize the following: The front-axle drive can be engaged or disengaged at any usual speed and in some vehicles at a stop. If you cannot do this with reasonable effort while the vehicle is stopped, it is probably one of those front-axle drives that can be engaged or disengaged only while the vehicle is in motion. Don't bend or break the control lever. Try shifting after the vehicle has been put in motion. Demonstrate the above point on the type or types of vehicles available. Point out that, with the transfer case in low range, shifting through the various transmission gears is still utilized for changes in power ratios and is performed in exactly the same way as previously learned.

c. Speed cautions.—Emphasize that drivers must guard against damage to their vehicles when driving in low range, with the front wheels engaged, by never driving faster than the speeds prescribed for each gear on the road speeds caution plate in the cab. Have students name or read off the maximum permissible speeds for low-range operation of the following gears: reverse, first, second, third, direct, overdrive.

159. Operating in high range, front axle engaged.—Explain that after the front axle is engaged, the transfer case may be operated in either high or low range; high being used when it is desired to use the pulling power of the front wheels but the going is not sufficiently heavy to necessitate use of the lowest gear ratio. Remember that front drive should not be engaged when driving on dry, hard-surfaced roads. Have assistant instructor describe shifting transfer case high

and low speed shifting lever from low range through neutral into high range. Point out that this shift can be made at any usual speed. Have the assistant instructor demonstrate this shift with the vehicle in motion. Have the students name or read off the maximum permissible road speeds for the various transmission gears with transfer case in high range position.

160. Disengaging front axle.—Explain that if, when operating in low range with front axle engaged, the driver wishes to disengage the front axle, he must first shift the transfer case high and low range shifting lever into high position and then move the front-axle declutching lever into disengaged position. Have assistant instructor operate a vehicle and demonstrate. Ask for questions and clarify any points not thoroughly understood.

161. Student practice.—Have the student drivers drive vehicles with assistant instructors sitting on their right. Under supervision of assistant instructors, have student drivers practice shifting the transfer case from low to high position and back again, until they can perform all shifts correctly without hesitation. Repeat this practice until student drivers are proficient in shifting into the transfer case low and high ranges and engaging and disengaging the front-wheel drive.

C(1)—GENERAL RULES OF THE ROAD AND SAFETY PRECAUTIONS

162. General.—*a. Objective.*—To develop in student drivers an understanding of, respect for, and the habit of observing safety precautions, rules of the road, and traffic regulations, both civil and military, as opposed to the tendency to follow individual inclinations.

b. Place.—Classroom.

c. Teaching aids.—Blackboard, diagrams, charts, Training Film 11–552, and photographs.

d. References.

TM 10–460, Driver's Manual.
FM 25–10, Motor Transport.
Motor Transport School Text No. 16, Military Motor Transportation.

163. Introductory remarks.—*a.* Point out that student drivers have been taught how to operate their vehicles with a considerable degree of proficiency on the driving range under supervision. Add that this training has been planned to prepare them to drive their vehicles on the streets and highways where they will usually not be

under any supervision, and where they will be driving in all sorts of civilian and commercial traffic.

b. Ask the question: Is there any reason why you should not take your vehicles out in traffic at the present stage of your training? Single out those who answer "yes" and get them to give you their reasons why they feel they are not yet qualified to drive in traffic. Note particularly those reasons which concern traffic regulations and rules of the road. Having brought out that some of the class realize that they must know the traffic rules and regulations before driving in traffic, start a discussion that will bring out the following reasons why traffic rules and regulations are necessary:

(1) Drivers would not know what other drivers were going to do unless there was a set of rules which all drivers observe.

(2) Two vehicles cannot be in the same place at the same time; therefore, drivers should know when and under what circumstances they should give the right-of-way to others.

(3) Those drivers who like to assert themselves by disregarding the rights of others must be restrained from doing so and punished if they continue.

(4) If there is a set of regular rules which all drivers observe, traffic will move more smoothly and efficiently, just as in playing a game teamwork is better when all players understand the rules.

(5) Experience has shown that the chief cause of traffic accidents is disregard of traffic regulations.

(6) The public gets its impression of the nation's armed forces by the way they conduct themselves in public; therefore, Army drivers must conduct themselves in traffic in a way that will reflect credit upon the Army.

(7) Army drivers must obey all civilian traffic regulations at all times, except when specific orders are issued to the contrary, at which time special military precautions will be taken to protect civilian traffic.

c. At this point, if possible, have a showing of Training Film 11-552, which in 20 minutes provides an overview of hand signals and road rules and regulations.

164. Signaling.—Ask why drivers, when about to slow down or change direction, should warn other drivers well in advance of what they are going to do. Explain that drivers may give such warnings by hand signals, by use of mechanical devices, and also by a gradual change in the direction of the vehicle. (Point out that although military vehicles are not equipped with mechanical signaling devices,

military drivers must be able to recognize these devices and their signals when driving in civilian traffic.) Stress that military drivers should be on the alert and prepared to act quickly in case other drivers fail to give any advance warning signals.

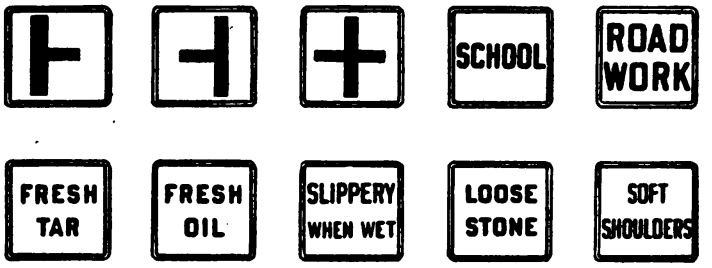
165. Signs, signals, and markings. — *a. Signs.* — Emphasize that whenever both a fixed sign or signal and a police officer, or a military guard, are present, the fixed signal should be ignored and the police officer obeyed. Ask if there is any reason why highway signs have different shapes. (Because the shape indicates the general meaning and the driver can get the general idea before coming close enough to see the letters or other details.) (See fig. 21.) Draw a blank diamond-shaped sign on the blackboard. Ask the class to tell you some of the warnings found on signs of this shape. As correct answers are given, write them in the blank sign one at a time, erasing each in turn before writing the next. Add a few more taken from figure 21. Emphasize that all the warnings on diamond-shaped signs call for reduced speed. Follow the same procedure in teaching the significance of the shapes of square signs, which mean *caution;* octagonal signs, which mean *stop;* and round signs or cross bars, which mean *railroad crossings.* Stress the importance of observing all highway signs by calling attention to the fact that such signs were installed by highway engineers for the purpose of preventing accidents. Mention that there are many more kinds of signs in addition to these and that the men should be on the lookout for them. Warn that symbols on the signs, such as those for crossroads and curves, will vary in many states. Stress the fact that a good driver heeds the warning on all signs.

b. Traffic lights.—Briefly mention that red means *stop*, yellow means *caution—prepare to stop*, and green means *go ahead with care.* A flashing yellow means *proceed slowly with caution*, and a flashing red means *stop*, *look*, *and proceed with care.* Point out that the position and location of traffic lights vary throughout the country and that there are also many different kinds of traffic lights.

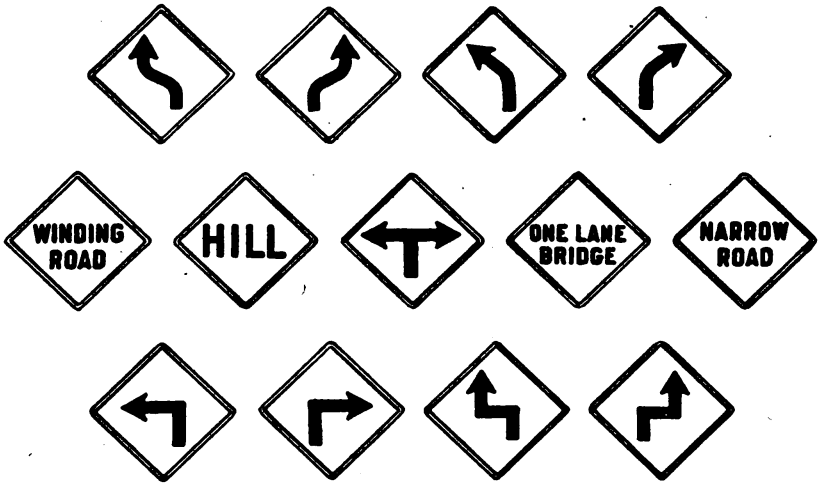
c. Markings.—Bring out the following points about highway markings:

Ten years ago center lines were little used, but today we depend on them a great deal. Different types of center lines are used in different states. A double line is now widely used as a warning not to cross the center of the highway in order to pass another vehicle. In some states a broken line is used in addition to the solid center line for the same warning, and other states use colored lines for this

purpose. Call attention to other markings such as those which designate crosswalks, reduced-speed zones, and approaches to railroad crossings.



SQUARE SIGNS MEAN CAUTION



DIAMOND SIGNS MEAN REDUCE SPEED

OCTAGONAL SIGNS
MEAN STOP

ROUND SIGNS
MEAN RAILROAD CROSSINGS

FIGURE 21.—Road signs.

166. Keeping to the right.—*a.* Discuss the following statements:

(1) Always drive on the right side of the road except on one-way streets and when it is necessary to drive to the left to pass slower moving or parked vehicles.

(2) "Don't hog the road."

b. Point out that—

(1) Sometimes the road is too narrow for one vehicle to pass another easily. When this occurs, a vehicle trying to pass may be forced into the ditch or into a pole unless the vehicle ahead moves over and gives sufficient room.

(2) When a vehicle approaches from the rear and indicates that it is going to pass, drivers should pull over to the right and, if necessary, slow up or even stop to give room.

(3) Good drivers never speed up when being overtaken except to provide room for the driver wrongfully attempting to pass to get back into column to avoid colliding with an oncoming vehicle.

167. Passing.—*a. General rules.*—State emphatically that poor judgment when passing is a major cause of traffic accidents. State that the following are common sense rules for passing, and read them slowly and emphatically:

(1) The generally accepted rule of the road requires you to pass on the *left* of a vehicle which you are overtaking.

(2) Never overtake and pass other vehicles except when the road ahead is clearly unobstructed for a sufficient distance so that you will be sure that you can complete the operation safely (get back into line safely). Point out that there are certain situations when passing is particularly dangerous and should never be attempted. Ask the class to tell you what, in their opinion, these situations are. Discuss in detail (*b*, *c*, and *d* below) the reasons why drivers should not pass under these specific circumstances:

Approaching or rounding a curve.
Approaching the crest of a hill.
Approaching or passing through an intersection.

b. Passing on curves.—Ask the class to give reasons why passing on a curve is dangerous and to give specific cases where accidents resulted, explaining why the accidents occurred. Make a large blackboard drawing of figure 22. Point to drawing and ask class what might happen if car A attempted to pass car B and what the driver of car C should do in a situation like this. Emphasize that the danger of an accident in such a situation would probably be much greater after dark. Bring out the factors which would increase the danger at night, such as the increased difficulty of judging distances and speeds, headlight glare, and the possibility that one or more of the cars might be driving with only one headlight on. Point out the value of observing center lines when passing on curves and also of observing the "No Passing" signs.

c. Passing on hills.—In discussing passing on hills, point out that passing on hills is the cause of a great number of head-on collisions which are nearly always fatal. Stress that it is often dangerous to pass on hills for the following reasons:

(1) Drivers may not be able to see vehicles which may be approaching the crest of the hill from the opposite direction.

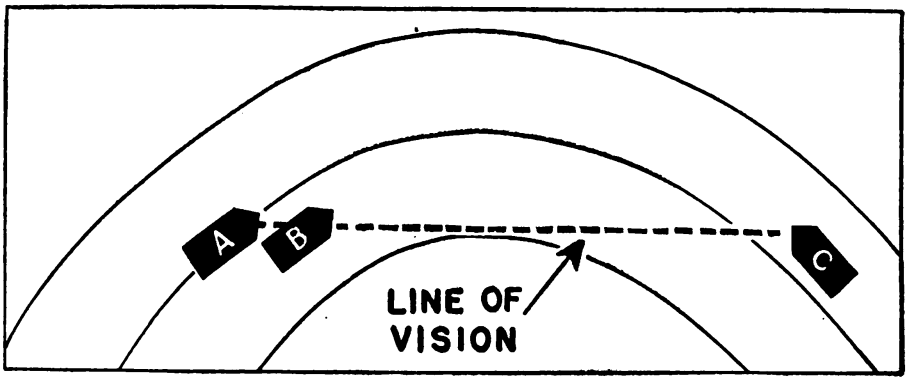


FIGURE 22.

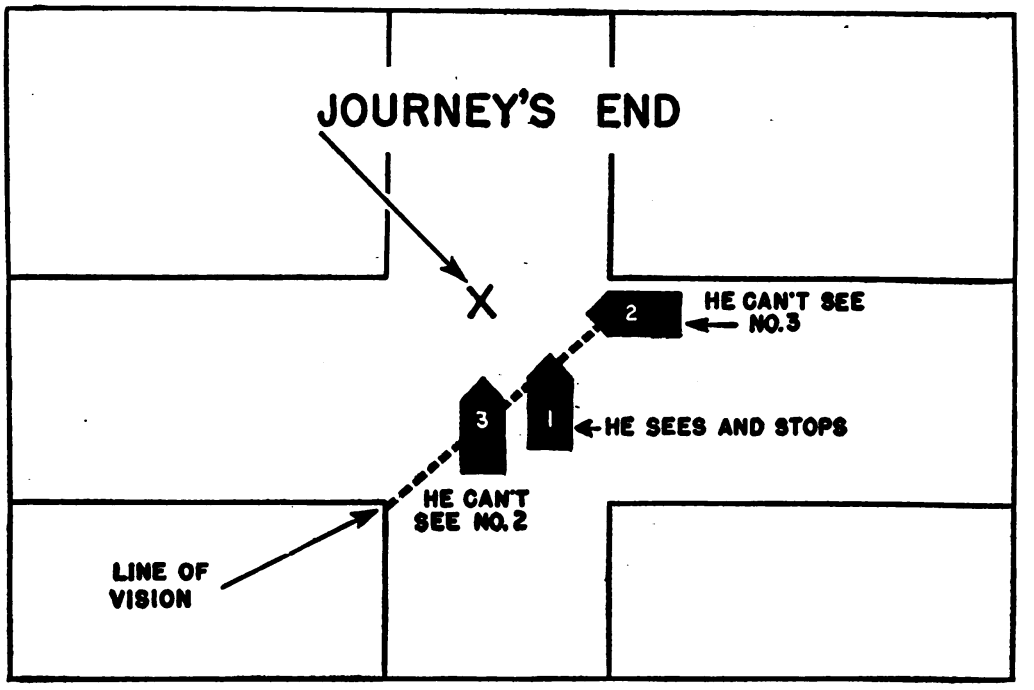


FIGURE 23.

(2) It takes more distance, more time, and more engine power to pass a vehicle when ascending a hill.

d. Passing at intersections.—Most cities and states recognize the danger of passing at intersections by prohibiting such passing.

Draw large blackboard diagram of figure 23. Show that if driver of car 3 attempts to pass car 1 he cannot see car 2 approaching from the side. (This is only one reason for not passing at an intersection.) Do not erase diagram as you will refer to it later. Ask members of the class to describe other situations when drivers should not pass at intersections (such as another vehicle approaching from the left; a vehicle coming from the opposite direction to which cars 3 and 1 are traveling and making a left turn, etc.). Diagram these on blackboard and explain.

e. Pedestrians.—If pedestrians are not mentioned, mark an X on the diagram directly in front of car 1 which signifies a pedestrian crossing the street. Show that the driver of car 3 cannot see the pedestrian.

f. Tunnels or bridges.—Tell student drivers that it is both against the law and dangerous to pass when approaching tunnels or bridges.

168. Right-of-way.—Point out that traffic regulations regarding right-of-way are fairly uniform in the United States, but that they do vary somewhat. Add that in foreign countries they often vary greatly. Write the following on the blackboard, explaining that it is a rule which is uniform throughout the country:

> WHEN TWO VEHICLES APPROACH AN INTERSECTION SIMULTANEOUSLY AT AN ANGLE, THE VEHICLE ON THE LEFT SHALL YIELD THE RIGHT-OF-WAY TO THE VEHICLE ON THE RIGHT.

Explain that the meaning of right-of-way should be interpreted as when to *give* the right-of-way to others rather than when to *take* the right-of-way.

a. Right-of-way rules.—Give the following rules for right-of-way and emphasize that all drivers should observe them, illustrating rules by drawing figure 24 on the blackboard:

(1) Give the right-of-way to all vehicles approaching from your right.

(2) When entering or crossing a main highway or boulevard, give the right-of-way to all vehicles on that highway, no matter whether they are coming from the right or the left.

(3) Always give the right-of-way to pedestrians, unless you are sure that they have extended it to you.

(4) Come to a full stop and give the right-of-way whenever you approach a "STOP" sign.

(5) Give the right-of-way to all police and fire department vehicles, ambulances, and other emergency vehicles.

(6) Give the right-of-way to funeral processions.

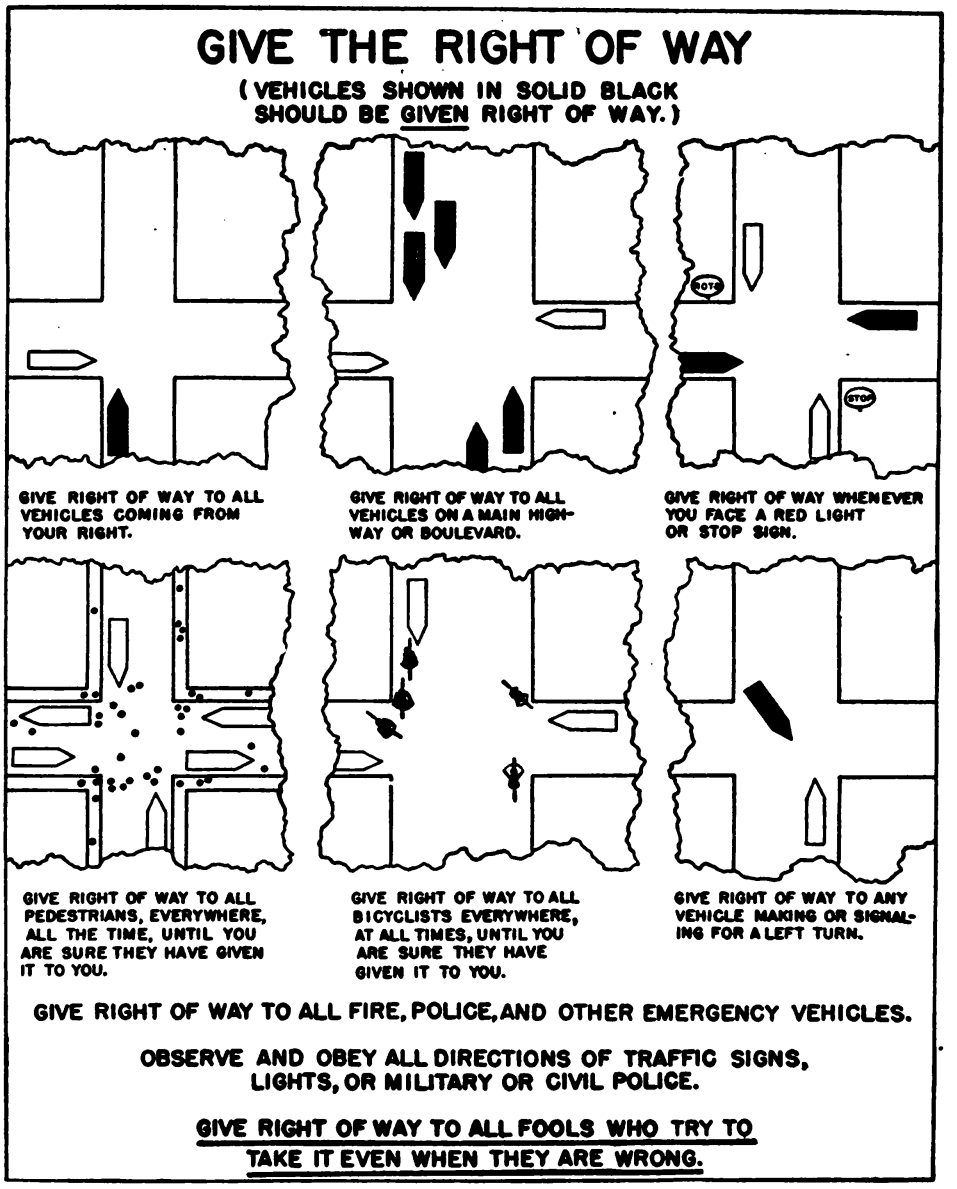


FIGURE 24.

b. Right-of-way hints.—Point out that the following are not rules, but that they are valuable hints to keep in mind when determining who has the right-of-way:

(1) The one safe guide is to keep your vehicle under control and be ready to stop, no matter who, according to law, has the right-of-way.

(2) Remember that the other fellow may not know the rules covering right-of-way, or may be one of those who tries to bluff his way through.

(3) It is wise to give the right-of-way to any driver who has not shown clear signs that he will give it to you.

(4) A good driver will give the right-of-way to persons on bicycles when he is not sure what they are going to do.

(5) Military or civil police have authority to modify right-of-way rules for special reasons. Obey their orders.

169. Left turns.—*a.* Emphasize that before making any kind of turn, it is a highly desirable practice to look in the rear-view mirror. Ask the class why this is so. Commence the discussion of left turns by asking the question: Is there more than one correct way to make a left turn at an intersection?

b. After getting several answers from members of the class, state the following rules which apply at all times:

(1) A driver making a left turn should give the approved hand signal: left arm extended straight out, as shown in figure 26. (Demonstrate.)

(2) A driver making a left turn must approach and start the turn from the center lane or left side of his half of the roadway.

(3) A driver making a left turn must yield the right-of-way to all vehicles coming from the opposite direction which the turn might block or hinder.

(4) A driver making a left turn must always enter the right half of the street into which he is turning.

c. Draw figure 25 on the black board. Sketch the diagrams of the intersections, and ask the class to explain the point of each.

170. Right turns.—Using the diagram, point out the proper method for making a right turn. Demonstrate the approved hand signal for right turn: left arm extended at an angle of 45° above the horizontal, as shown in figure 26. Point out a fault which many poor drivers have (swinging wide to the left before turning right). Ask the question: What might happen if a driver making a right turn swung too wide to the left in heavy traffic?

171. Speed.—Ask several students to tell you the maximum speed laws in their states. Write on the blackboard the following speed rule and state emphatically that it must always be observed:

ALWAYS LIMIT YOUR SPEED SO YOU CAN SEE CLEARLY THE DISTANCE AHEAD WHICH YOU WOULD REQUIRE FOR AN EMERGENCY STOP.

a. Factors in regulating speed.—Ask the class to name all the factors that they can think of which should be considered in determining safe speed. (The amount of traffic; whether or not you are driving in a congested district; day or night; weather conditions; condition of the vehicle; your driving ability, etc.) As conditions are named, list them

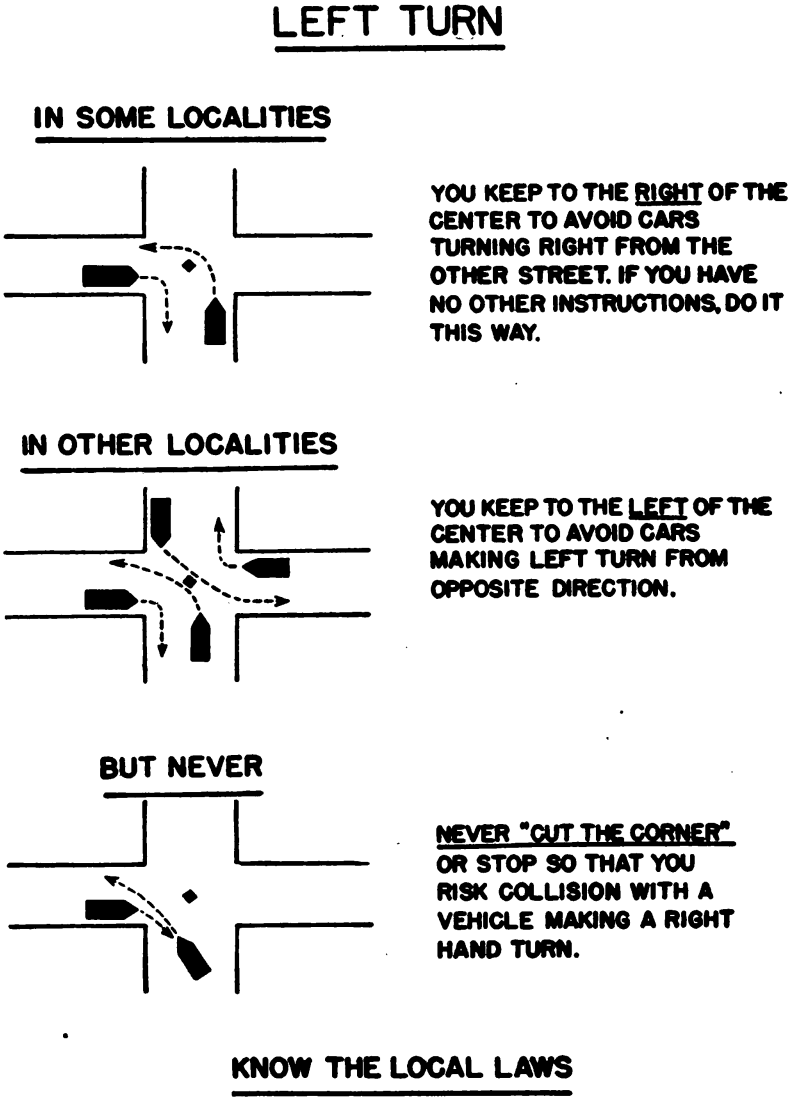


FIGURE 25.

on the blackboard. Point out that if a driver is tired, ill, or otherwise below par, he may not be sufficiently alert or in good enough physical condition to act quickly and correctly in an emergency. Emphasize that if the mechanical condition of a vehicle (brakes, tires, lights, etc.) is questionable, speed should be reduced. Point out that

all the state and local laws regulating speed were made because conditions are such that exceeding the posted speeds is dangerous. Emphasize that drivers should familiarize themselves with the speed laws of the States and cities in which they operate and observe them at all times, unless specific military orders are issued to the contrary.

b. Dangerous effects of speed.—Give a brief talk on the dangerous effects of speed, bringing out the following points:

(1) Speed (too fast for existing conditions) is the chief cause of accidents. Speed violations are reported to be a factor in one-third of all fatal motor vehicle accidents in the United States.

(2) When driving at high speed, motor vehicle operators have less time to think and act in an emergency.

(3) It takes a far greater distance to stop in an emergency when driving at high speed.

(4) When speed is increased, the impact of collision in an accident is not increased proportionately, but according to the square of the increase in speed. This means that when speed is doubled, for example, the impact of a collision will not be twice as great but four times as great. Thus, at 40 miles per hour the impact will be four times as great as at 20 miles per hour. At 60 miles per hour the impact will be nine times as great as at 20 miles per hour.

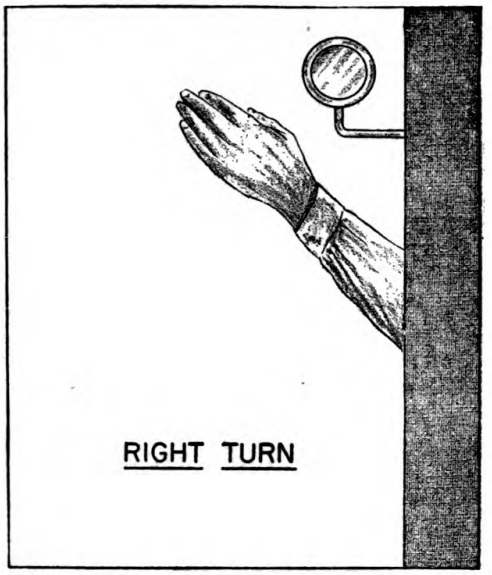
(5) Quote the following statement showing the effect of speed upon the severity of accidents:

> AT SPEEDS LESS THAN 20 MILES PER HOUR ONLY ABOUT ONE ACCIDENT INJURY IN 70 IS FATAL. AT SPEEDS OF 50 MILES AND OVER, ONE IN THIRTEEN.

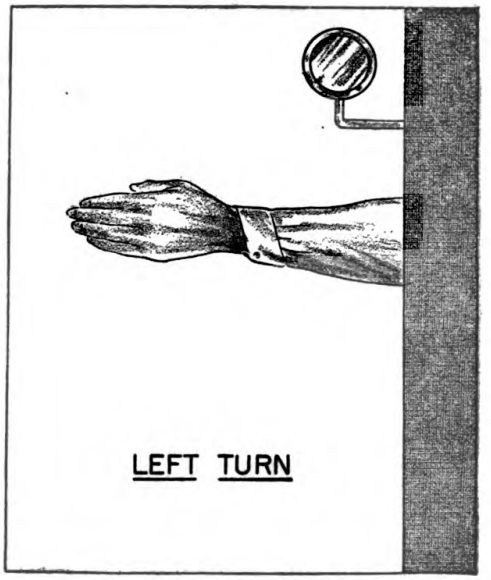
c. Economic effect of speed.—State that in addition to multiplying the danger of accident, driving at high speed causes greatly increased wear of the vehicle and consumption of gasoline and oil, and that because brakes are used more frequently at high speed, brake linings wear out more quickly. Tires wear out much quicker at high speeds. A tire will last only half as long if the vehicle is driven at 60 miles per hour as it will last if driven at 40 miles per hour. Due to the rubber shortage, tires on both military and civilian motor vehicles must be conserved.

172. Slowing down; stopping.—Ask the class to give you a list of conditions under which the driver should slow down, and write these on the blackboard. (When approaching intersections; when approaching or rounding curves; etc.) Point out that the "slow" or "stop"

hand signal (left arm extended at an angle of 45° below the horizontal as shown in fig. 26) should be given well in advance of the act of slowing or stopping.



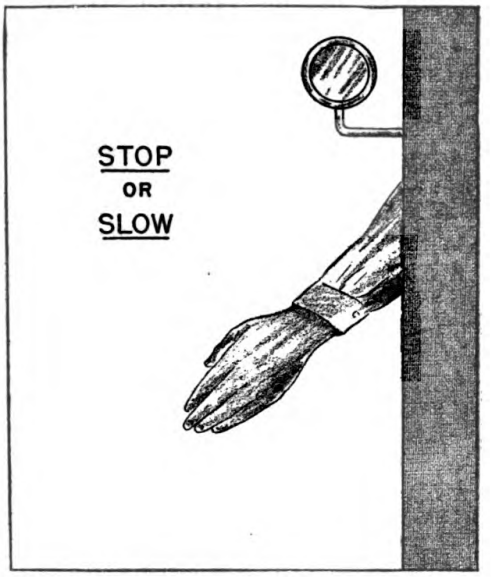
① Extend left arm at an angle of 45° above horizontal.



② Extend left arm straight out.

FIGURE 26.—Driver's hand signals.

173. Parking.—State the following general rule: park your vehicle off the traveled way where it will not interfere with the normal flow of traffic; where it will not obstruct the view of other drivers; and where it will not be parked in violation of the law.



③ Extend left arm at an angle of 45° below horizontal

FIGURE 26.—Driver's hand signals.—Continued.

a. Safe parking on highways.—Tell the class that you will first discuss parking from the standpoint of safety. Ask men to describe situations in which a parked vehicle is not entirely off the highway and is likely to cause an accident. (On a curve, when visibility is obstructed by trees or buildings, at night with the taillight out, near the crest of a hill, on a narrow two-lane road, etc.) Ask the class to explain how these and whatever other dangerous parking situations they can think of are in violation of the general rule you have stated. Point out that you will discuss the correct actions of drivers of military motor vehicles and passengers when parking (at halt), later in the course.

b. Parking on grades.—Ask a student driver to come to the blackboard and draw a rough sketch, showing how the front wheels of a vehicle should be turned when parking on an upgrade (outward from the curb). Have him also draw diagram showing how front wheels should be turned when parking on a down grade (inward toward the curb, as shown in fig. 27). Ask why the engine should be turned off while a vehicle is parked. Ask what other safety precaution is especially important. (Setting hand brake.) Point out that on a very steep grade, blocks may be used as a special precaution.

c. City parking regulations.—Read slowly and emphatically the following regulations which govern parking:

(1) Never park closer than 15 feet to a fire hydrant.

(2) Never park vehicle so that any part of it extends over the crosswalk. Discuss this so as to bring out the reason. (Obstructs view of other drivers at intersections, blocks pedestrians crossing street, etc.)

(3) Obey parking signs, including the time limits. Do not double park where your vehicle will obstruct traffic and cause traffic congestion. Never park at an angle when parking parallel to the curb is prescribed.

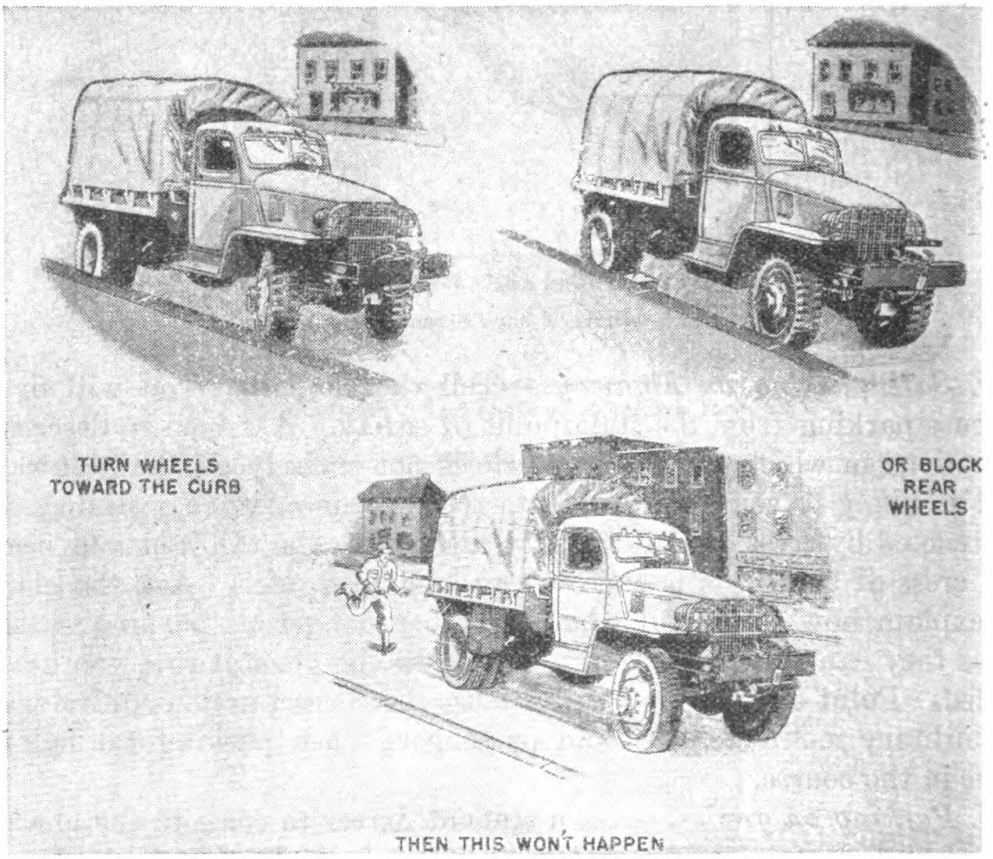


FIGURE 27.—Parking on a hill.

d. Added hints on parking.—Discuss the following points:

(1) In an emergency, it is sometimes necessary to park on the traveled part of the highway. In such a case, under conditions where a vehicle may be approaching from either direction, the driver should station men (wearing white handkerchiefs or cloths) in advance of and behind the vehicle, as necessary to warn other drivers. At night he should use flares.

(2) As soon as possible, the vehicle parked in a dangerous position should be moved to a safe place.

(3) In making minor repairs on the highway, the vehicle should be stopped where it is completely off the road and the driver (wearing a white handkerchief or cloth) should be constantly on guard against the danger of injury by passing vehicles.

174. Rules of the road—Practical applications.—The following is suggested as a particularly effective method of teaching traffic rules and regulations. It is a method which stimulates the interest of the class by asking the men to participate in the discussion. It may be used at any point to illustrate any rule or regulation on which you wish to place special emphasis or it may be used, as here at the close of the class session, after the rules and regulations have been taught, to assist in giving the men a clearer perception of how such rules apply in actual driving.

a. Ask the class to create an imaginary accident such as two vehicles colliding at an intersection or a head-on collision at the crest of a hill. Have the accident described in detail and, as it is described, draw the situation on the blackboard. When the class has finished giving you suggestions and you have finished drawing, you should have a diagram indicating all or many of the following:

(1) Curvature of the road, both vertical and horizontal.
(2) Obstruction to visibility.
(3) Location of vehicles; direction and speed of their movement.
(4) Time of day or night.
(5) Weather conditions.
(6) Condition of vehicle and drivers.

b. Mark the vehicles, A, B, and C, etc. Take each vehicle in turn and draw from the class their opinions of whether or not it was proceeding safely and, if not, how it contributed to the accident situation. List on the blackboard all the bad driving practices involved. Ask the class which of these practices were actual violations of traffic laws, and what laws were violated in each case.

c. Repeat the above with other imaginary accidents.

C(2)—TECHNIQUES IN ADVANCED DRIVING (LECTURE AND DISCUSSION)

175. General.—*a. Objective.*—To develop an understanding of the factors affecting motor vehicle operation on streets and highways; to acquaint drivers with the methods of driving efficiently under various traffic conditions.

b. Places.—Classroom.

c. Teaching aids.—Diagrams.

d. Reference.—TM 10–460, Driver's Manual.

176. Introductory remarks.—Make the following general comments: In order to be a good driver, the student must know more than the rules of the road and how to start and stop his vehicle, shift gears, drive forward and backward, and turn around and park. He must also know how to handle his vehicle out on the road where there are other vehicles, both civilian and military. He must know how to drive under all sorts of conditions of traffic, weather, visibility, curvature of road, etc. To do this well he must be able to see far ahead of the actual position of his vehicle, to determine whether or not what he sees may develop into a hazard, and to take action to avoid all hazards well in advance of danger; that is, he must be able to anticipate danger and guard against it by whatever action may be necessary.

177. Smooth car control.—*a.* Bring out by questioning what is meant by smooth driving:

(1) Gradual changes in speed and direction.

(2) Recognizing the need for use of brakes far in advance and slowing up as much as possible by merely letting up on the accelerator.

(3) Using brakes gently, except in emergency.

(4) Avoiding violent acceleration.

(5) Shifting gears without clashing and building speed gradually between shifts.

(6) Entering a curve slowly enough so that it will not be necessary to slow down while on the curve.

b. Point out that a driver who has smooth vehicle control generally has the following characteristics:

(1) Anticipation and good judgment.

(2) Does not let himself get rattled or impatient.

(3) Does everything possible to prevent wear of his vehicle.

178. Speed on curves.—*a.* Ask why it is dangerous to try to drive around a curve at high speed. (Vehicle will tend not to follow the curve, but to travel ahead in a straight line. This tendency is known as centrifugal force.)

b. Ask what conditions of the vehicle, the road, and the curve should govern the driver in controlling speed when entering and rounding curves. Make sure to cover the following:

(1) *Vehicle.*—Condition and equalization of brakes; gripping power in the treads of the tires; equal distribution of the load on all wheels.

(2) *Road.*—Slipperiness of the road; width of the road; whether or not the road is high crowned; whether or not the road is banked

or tilted up so that vehicles rounding the curve will be held on the road more readily.

(3) *Curve.*—Radius of the curve as a whole; radius at sharpest point of curve. (Illustrate these by drawing on the blackboard.)

c. Ask the class what the driver should do to guard against leaving the road on a curve. (Reduce speed before entering the curve to a point where it is obviously safe to round the curve considering both its sharpness and the roadway surface.)

179. Skids.—Point out that distance necessary in which to stop a vehicle increases greatly with the slipperiness of the road. (Stopping distances are often twice as great on wet roads as on dry roads and up to ten times as great on packed snow or ice.) Ask why this is so. (Because the tires do not grip the road, but slide over the road like skates or sled runners.) Ask what this effect really is. (A skid.) Clarify by pointing out that most people think of a skid as the action of a vehicle sliding sideways and perhaps spinning completely around. Actually, a vehicle is skidding even if it is only sliding straight ahead on the road. Point out that obviously the most dangerous sort of skid occurs when the vehicle starts to slide sideways or starts to slide when rounding a curve. Ask why this is so. (Because the vehicle is more likely to slide into another vehicle on either side or off the road into a ditch or telephone pole; or in the case of a curve it is likely to continue straight ahead off the road.) State that in addition to the slipperiness of the road, skidding is often caused by faulty acts of the driver.

a. Causes of skids.—(1) Ask what these may be and make sure that you get all the following answers, which you will write on blackboard:

(*a*) Applying the brakes too suddenly.

(*b*) Speeding up or slowing down suddenly.

(*c*) Sharp changes of direction.

(2) Point out that the three errors listed on blackboard are seldom made if the driver operates his vehicle slowly enough for the conditions.

(3) Point out that unequally adjusted brakes frequently cause skidding when they are applied because they slow the vehicle down on one side only, with the result that the vehicle tends to spin around the wheel which has the greatest braking power.

b. Hints on preventing skids.—Ask the class for additional ways to prevent going into a skid. Make sure to cover the following points:

(1) When starting on a slippery surface, start in low gear and engage clutch very slowly and carefully.

(2) Approach and round curves slowly and without changing speed. If there is still a tendency to skid, accelerate very slowly.

(3) When stopping on a slippery surface, leave the clutch engaged and apply brakes lightly and intermittently and only as much as absolutely necessary.

(4) Be on the alert when driving on dry leaves or loose gravel or sand, and along trolley tracks.

c. Getting out of a skid.—Ask the class how to get out of a skid that has started. Make sure to put across the following points:

(1) Do not jam on the brakes.

(2) Keep calm.

(3) Steer in the direction of the skid; that is, turn the steering wheel in the direction in which the rear of the vehicle is skidding, never in the opposite direction. (See fig. 28.)

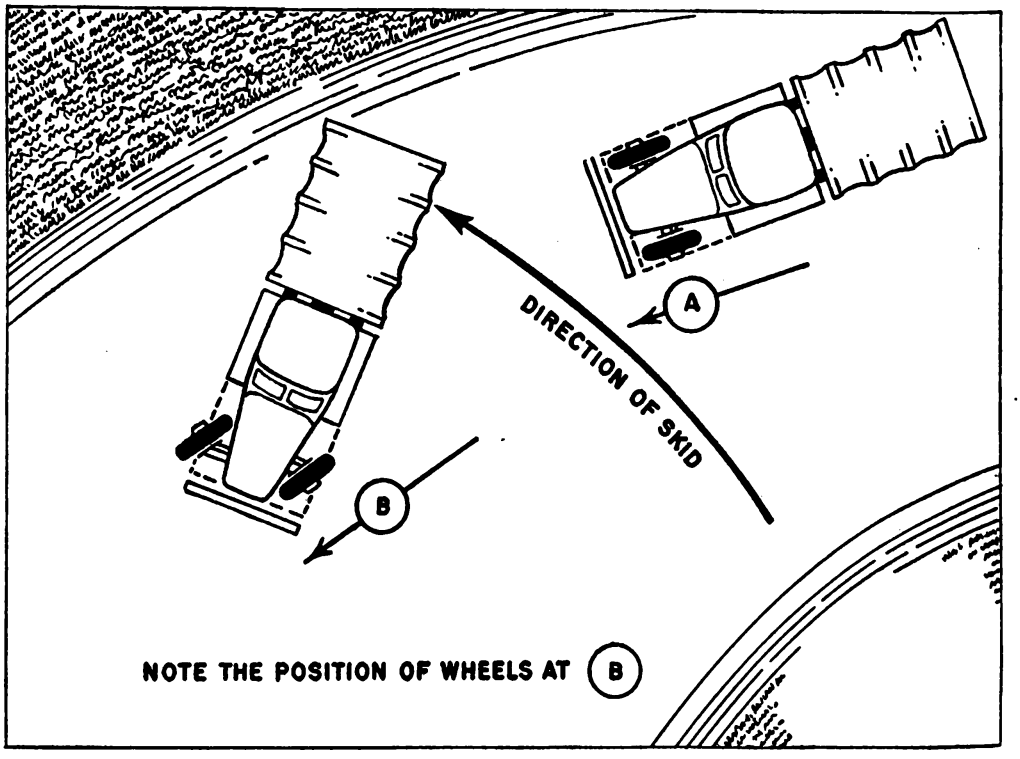


FIGURE 28.

(4) If the roadway ahead is clear, accelerate slightly and steadily.

180. Descending grades.—Point out that speed must be reduced when descending grades because it takes a greater distance to stop the vehicle than under other circumstances and that all the hazards you have discussed so far will increase in proportion to the steepness of the grade. Explain that the driver with good anticipation will always

survey the steepness of the descent and the extent to which the road curves for as far down the slope as he can see before starting down, and will slow down enough so that the vehicle will be under control throughout the entire descent. Add that the good driver shifts into the proper low gear before descending a hill. Point out that that gear is usually the same one that would be used for ascending the same hill.

NOTE.—Techniques for ascending and descending difficult grades are considered in detail in Unit 4H.

Point out that the driver should never coast down a steep grade (push down the clutch and let the vehicle roll while descending the grade). Emphasize that this is dangerous because the driver is too likely to lose control and unable to put the vehicle back in gear if it starts rolling fast, with the result that the brakes alone may not be able to hold the vehicle back. The good driver does not use his brakes any more than is necessary when descending grades. Point out that excessive use of brakes wears out brake linings and tires, and refer emphatically to the need for conserving rubber. Mention that a good driver conserves his brakes when descending grades by allowing the engine in low gear to do most if not all the braking.

181. Safe following distances; solo driving.—Discuss safe following distances in this manner: one of the chief causes of traffic accidents on the highway is the inability of drivers to judge correctly the distance at which they should remain behind the vehicles ahead. Some drivers crowd the vehicle ahead so closely that if there is an abrupt stop, a rear-end collision is caused, or they have to swing out into the path of the on-coming vehicles with the result that they may cause a head-on collision. The opposite fault is to stay so far behind that vehicles will be continually approaching and passing from the rear. This is leaving too long a distance between vehicles. It is particularly dangerous when the distance is not quite enough for vehicles from the rear to pass and enter the same lane ahead without having to cut in. The ideal following distance is one in which your vehicle is far enough behind the vehicle ahead so that there is no danger of striking that vehicle in case it stops or changes direction abruptly, but not so far behind that vehicles will be constantly attempting to pass.

182. General hints for highway driving.—Give the following general hints concerning highway driving:

a. Changes in width of road.—Be on the alert for places where the width of the road may change abruptly. This is especially important when driving at night, when your headlights may fail to show the

difference between the pavement surface of the wider stretch of road and the shoulder of the narrow stretch of road. In that case, you should be guided by the change in position of the vehicles ahead (sometimes three lanes will become two, etc.).

b. Railroad crossings.—Obey railroad stop-signs except when you have specific orders to the contrary. Cross tracks only if you are sure no train is approaching. If necessary, shift into a lower gear before crossing tracks so that vehicle will not stall.

c. Pedestrians.—Be on the alert for pedestrians walking on the highway, particularly at night. Unless it is necessary, do not drive too close to the right-hand side of the road, because too many pedestrians still walk on the right side of the road with their backs to on-coming vehicles, and also many wear dark colored clothing which makes it very hard to see them even with good headlights.

d. Brake failure.—In the event that your hydraulic brakes fail, pull up the hand brake, shift into second gear, and turn off the ignition.

e. Blow-outs.—If you have a blow-out, the vehicle will probably swing toward the side on which the blow-out occurs. With a firm grip on the wheel, hold the vehicle's forward motion in a straight line on the highway, allowing the drag of the flat tire to reduce speed. Apply the brakes only when you are sure you can control direction. Do not make the mistake of steering sharply in the opposite direction and jamming on the brakes, because if you do this, you may completely lose control of your vehicle.

183. Safeguards for city driving.—*a.* Ask the class what the chief differences are between driving on the open highway and driving in cities, or through towns or villages. Have them list hazards of city driving.

b. Summarize as follows what the driver must do if he is to drive safely in city traffic under ordinary conditions:

(1) Be extremely observant and obey all signals.

(2) Be prepared at all times to prevent accidents caused by mistakes or unexpected actions of others.

(3) Make right and left turns properly.

(4) In general, drive more slowly than when on the open highway. (This gives the driver more time to observe hazards and to allow for them.) Obey all speed rules.

(5) When approaching a light that is about to change, proceed through the intersection only if sure that you can complete the crossing of the intersection before the light changes. If in doubt, stop.

(6) If stopped by a red light, start again only after the yellow caution light or the red light has changed to green.

(7) When stopping at an intersection, stop so that the front wheels of your vehicle will not obstruct pedestrians crossing the street.

(8) Remember that ambulances, fire engines and police cars have the right-of-way over all traffic, both civilian and military, unless you have specific orders to the contrary. Pull to the curb, and let them pass.

(9) Never pass a standing trolley car or school bus that is discharging or taking on passengers where there is no safety zone. Stop far enough back so that the front bumper of your vehicle is behind the public conveyance.

(10) Be especially watchful for signs indicating one-way streets and avoid driving the wrong way on them.

184. Night driving.—*a. General.*—Point out the following factors which call for special caution at night:

(1) Headlights illuminate the road clearly for only a few hundred feet. The driver who is speeding actually may not be able to see as far ahead for as great a distance as he would require to stop if his vehicle came upon a truck parked in the road with taillight out or upon some other obstruction.

(2) When rounding curves the headlight beam slants diagonally across the road with the result that the road may be illuminated for only a few feet ahead.

(3) It is impossible to determine what is ahead (curve, hill, etc.) until it is actually revealed by the headlights.

(4) After exposure to the glare of approaching headlights, the driver is partially blind for several seconds.

b. Aids at night.—State the following aids to visibility when driving at night (not under blackout conditions):

(1) Keep the windshield clean. (If the driver wears spectacles, these should also be kept clean.)

(2) Drive on the right-hand side of the road whenever practicable.

(3) Avoid looking into the headlights of all oncoming vehicles by looking at the center line of the road or the right shoulders of the road.

(4) Depress headlights when approaching other vehicles. (If you will extend this courtesy, other drivers will probably extend it to you.)

(5) Use the lower headlight beam to reduce the reflected glare caused by moisture (fog or rain) in the atmosphere or on the road.

(6) Drive at speeds which permit you to stop within the distance you can see ahead.

C(3)—ACTUAL PRACTICE IN ADVANCED DRIVING

185. General.—*a. Objective.*—To develop in student drivers, through guided practice, the ability to handle vehicles safely and skillfully on the open highway and in city traffic.

b. Place.—On streets and highways.

c. Equipment and materials.—One vehicle for each student driver. Copies of Preventive Maintenance Schedules Nos. 2, 3, 4, and 5 for each student driver and assistant instructor.

d. Personnel.—As many assistant instructors as possible.

e. Notes to instructor.—This part of the section on advance driving deals with actual practice by the student drivers. No man should be permitted to take a vehicle out for advanced driving practice until he has successfully completed Unit 4B. Further practice in advanced driving will be provided in connection with motor marches and convoys, as described in a later section. If necessitated by local circumstances, practice in city driving may be omitted from this part of the course and provided solely in connection with motor marches.

186. Practice routes.—The chief instructor should select definite routes for driving practice—one presenting situations which will require student drivers to traverse hills, curves, intersections, traffic signs and signals, etc., as indicated in the check lists at the end of this part. The routes should not have too much traffic or present too many complex driving situations.

187. Before-operation inspection of vehicle.—As soon as vehicles and students are assigned, have your student driver perform the before-operation check (PMS No. 3). Be sure he performs this check thoroughly and smoothly and in a minimum of time. Now point out that beginning with practice in advanced driving, they will from then on through the balance of the course be expected to carry out the preventive maintenance schedules every time they operate a vehicle.

188. Practice on open road.—Now have student driver begin road practice on the open road selected by the chief instructor. While he is driving, make mental note of any weaknesses in his performance of the functions listed in Check List No. 1. This driving course is, or should be, sufficiently varied to provide an opportunity for the student to perform at least once each of the functions listed.

189. During-operation check.—After you have been on the road awhile, have student driver make the during-operation check (PMS No. 4). The student driver is supposed to know the regular during-operation check; however, if he fails to make all required checks, point out his omissions. If necessary, have student driver repeat this check while driving.

190. Further driving on open road.—After completion of the during-operation check, have student driver continue driving on the highway. Continue to note any weaknesses in his performance of the functions listed in Check List No. 1. After a period of such driving, tell the student to pull off the road. Get out of the vehicle and check as "Satisfactory" or "Unsatisfactory" all of the items listed in Check List No. 1. Point out to the student the weaknesses he may have shown.

191. Check lists for judging performance.—Study sufficiently in advance the three check lists that have been provided for your use in judging performance of student drivers and to guide you in determining what faults of student drivers need special corrective attention. These check lists are:

No. 1, Specific driving ability and skill of student in highway driving.

No. 2, Performance of student in city driving.

No. 3, General ability and behavior of student driver.

After each practice session, fill out the check list which applies to the practice just concluded, and turn in these pages to the chief instructor. He in turn will give them to the assistant instructor (who may or may not be you) who takes the student out for the next day's practice. Each assistant instructor will thus be able to determine the proficiency of the student assigned to him. As each fault is corrected, the "Unsatisfactory" rating should be crossed out and the "Satisfactory" rating substituted. In this way, an up-to-date record of each student's progress will be kept.

192. At-halt check.—Tell the student driver to perform the at-halt check (PMS No. 5). Be certain that the student driver is familiar enough with his procedure so that he can perform it smoothly and thoroughly and with a minimum of time. If time permits, have student continue driving. Revise check list to conform with student's progress, each time, pointing out to him any faults.

193. City driving.—Make sure that the driver has demonstrated competency in open highway driving before leading him into complex city traffic. Repeat open road practice until this competency has been demonstrated. Select a route for city driving which includes all kinds of traffic conditions; that is, pedestrians, trucks, passenger vehicles, stop signs, traffic lights, etc. Now have student driver begin practice in city driving. While he is driving make mental note of any weaknesses in his performance of the functions listed in Check List No. 2. Make sure that he has an opportunity to perform at least once each of the functions listed in this check list. After a period of such driving, have the student return to the place from which he

started, and tell him to park his vehicle. Then rate him as "Satisfactory" or "Unsatisfactory" in each of the skills listed in Check List No. 2 and explain his faults. Repeat practice until his faults have been eliminated.

194. After-operation check.—When each day's practice has ended, have student perform the After-operation check (PMS No. 2). Make sure that student performs this check thoroughly and correct any errors that he may make.

195. General ability and behavior.—After each practice session, use Check List No. 3 to rate the student's general ability and behavior. Rate him as "Satisfactory" or "Unsatisfactory" on each of the items listed, and explain to him any shortcomings.

CHECK LIST NO. 1

SPECIFIC DRIVING ABILITY AND SKILL OF STUDENT DRIVER IN HIGHWAY DRIVING

Name of student_____	*Satisfactory*	*Unsatisfactory*
1. Passing through highway intersections.		
2. Stopping at stop signs.		
3. Making right and left turns.		
4. Approaching and crossing railroad tracks.		
5. Stopping and starting on an upgrade.		
6. Stopping and backing on a downgrade.		
7. Turning the vehicle around on a narrow road.		
8. Turning the vehicle around in the width of a street on a hill.		
9. Turning the vehicle around using a Y-turn.		
10. Overtaking and passing another vehicle.		

Period 1 Period 2 Period 3 Period 4 Period 5

Date_____

Signature of assistant instructor_____

CHECK LIST NO. 2

STUDENT DRIVER PERFORMANCE IN CITY DRIVING

Name of student_____	*Satisfactory*	*Unsatisfactory*
1. Starting the vehicle and driving using all gears.		
2. Smoothness in stopping.		
3. Stopping for signs and signal lights.		
4. Driving at proper speed.		
5. Approaching intersections.		

6. Passing through intersections.
7. Driving in correct lane.
8. Making left and right turns.
9. Watching out for pedestrians.
10. Following the vehicle ahead.
11. Using hand signals.
12. Giving the right of way.
13. Parking at an angle.
14. Parking parallel by backing in.
15. Driving out of a parking place.

Period 1 Period 2 Period 3 Period 4 Period 5

Date_____

Signature of assistant instructor_____

CHECK LIST No. 3

GENERAL ABILITY AND BEHAVIOR OF STUDENT DRIVER

Name of student_____	*Satisfactory*	*Unsatisfactory*
1. Shows good attitude at all times.		
2. Does not appear nervous or excited.		
3. Follows instructions and suggestions.		
4. Is cooperative when meeting other vehicles or pedestrians.		
5. Drives in correct lane at all times.		
6. Gives appropriate hand or horn signals.		
7. Drives at a proper distance behind other vehicles.		
8. Decreases and increases speed smoothly.		
9. Though alert, appears relaxed.		

Period 1 Period 2 Period 3 Period 4 Period 5

Date _____

Signature of assistant instructor _____

D—MAP READING

196. General.—*a. Objective.*—To develop in student drivers the ability to find their way to any given destination by the use of maps and compasses.

b. Place.—Classroom and highway.

c. Materials.—Maps of various sorts, both civilian and military; blackboard; colored chalk; vehicles.

d. Personnel.—One instructor.

e. References.

FM 25–10, Motor Transport.
TM 10–460, Driver's Manual.
FM 21–25, Elementary Map and Aerial Photograph Reading.
Driver Training Film 11–556.

197. Importance of map reading.—Assemble student drivers in classroom and furnish them with various sorts of maps. Name the following maps which are in common usage: United States road maps, regional maps, State road maps, metropolitan area maps, city street maps. Point out that soldiers must know how to read maps because they are frequently given individual missions which will require them to travel considerable distances into unfamiliar territory, using only a map as a guide.

198. Standard map symbols for roads.—Point out that map makers use a standard set of symbols which have definite meanings. Draw on the blackboard an unbroken line and point out that on maps with little detail, roads are usually indicated by such lines. If only a line is used to indicate a road, it will give no information concerning the type of road whether it is good or bad, etc. Draw on the blackboard the symbols shown in figure 29①. Identify them as the symbols for primary road, hard surface, improved surface; secondary road; and railroad. Erase the diagrams from the blackboard and have several student drivers come to the front of the class and draw these various symbols from memory. Point out and correct all errors.

199. Other important map symbols.—Now draw and explain in turn the symbols shown in figure 29②: bridge; ferry; ford; railroad grade crossing, railroad above crossing, railroad beneath crossing. Repeat the procedure of having several students come to the blackboard and draw these symbols from memory while you point out and correct errors. Continue demonstration, explanation, and student practice, for all of the following symbols shown in figure 29③: buildings, church, hospital, cemetery, and school.

200. Use of grids.—Point out that on maps which contain a great deal of detail, it is difficult to locate a specified point unless there is some means provided to guide the reader's eye to that point on the map. Explain that this is accomplished by means of a system of grids, or ruled north-south (up-and-down) and east-west (right-and-left) lines on the map. Indicate that these lines, both horizontal and vertical, are numbered, so that if a person were asked to find a point indicated by numbers 2 and 4, for example, all he would have to do would be to follow these two lines to their point of intersection. Show

by a diagram on the blackboard (fig. 30) how point 2–4 would be at the point where line 2 (reading first to the right) and line 4 (reading up) cross. "Read right, up" is a phrase to be impressed on the men for reading Army maps. Indicate that actually the driver will seldom be looking for a point that falls exactly at the crossing of two lines; instead of being told to drive to location 2–4, he may be directed to 2.5–4.3. Exactly the same procedure of reading right, up is to be

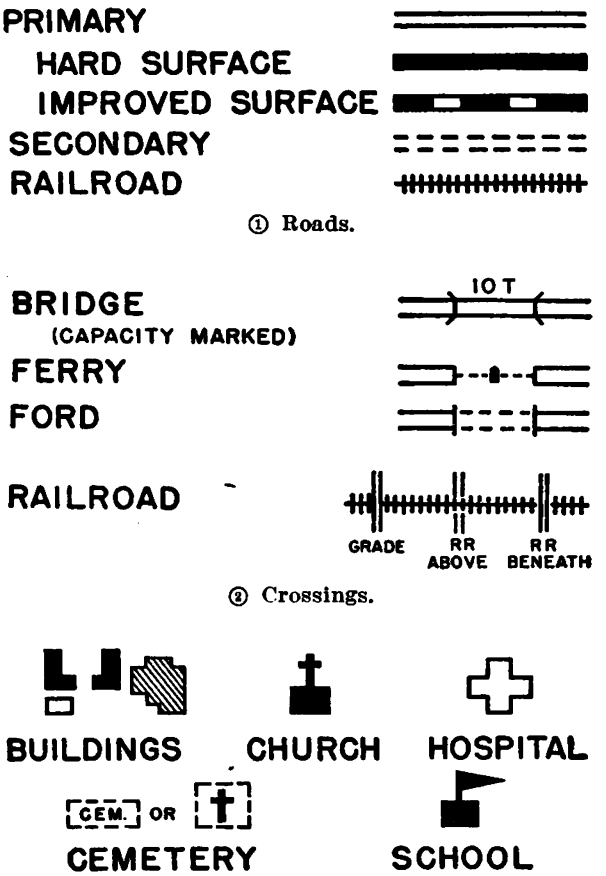


FIGURE 29.—Map symbols commonly used.

followed but the driver reads to the right to a point halfway between line 2 and line 3 and he reads up to a point about one-third of the way between line 4 and line 5.

201. Strip maps.—Hold up a strip map and explain that these maps, being prepared especially for individual trips, do not have grids and often do not have scales. Emphasize that when following strip maps, it is particularly important for the driver to pay close attention to the details of the landscape indicated on the map.

202. Scale of maps.—Point out that, obviously, maps must be smaller than the terrain they represent, and that therefore they must be drawn to scale. Explain that the scale to which a map is drawn is indicated on the map either by a fraction, such as $\frac{1}{1000}$, in which case the distance on the map will be only one 1000th as long as the actual distance the map portrays; or by a small scale printed on the map which states the number of actual feet or miles any given distance on the map represents.

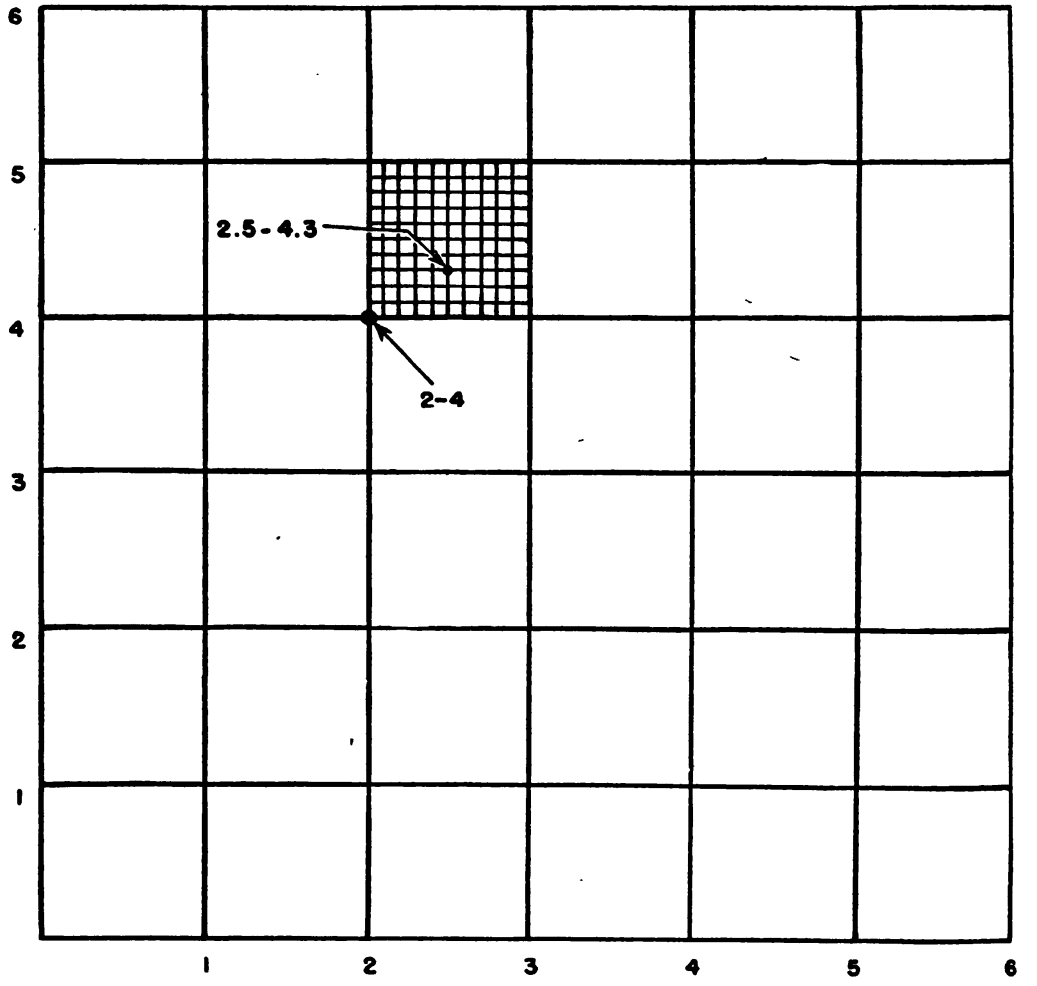


FIGURE 30.—Locating a point on a grid.

203. Determining distance from scale.—*a.* Explain that once the scale of the map is known, it is not difficult to determine an actual distance. Point out and demonstrate one way of determining the distance between two points, as follows:

(1) Lay the straight edge of a piece of paper along the two points on the map.

(2) Mark the location of the two points on the straight edge.

(3) Place the marked straight edge beside the map scale and estimate the distance.

b. Point out that in some cases the routes on the map are so irregular or crooked that it is difficult to estimate the distance in the manner just given. Explain that when this is so, the crooked line should be divided into several approximately straight sections which should be added together to determine the total length of the crooked line. The length found should then be compared with the scale.

204. Contour lines.—Explain that to be of the fullest practical value, maps should convey to the users definite information concerning the ground forms, such as hills, ridges, and valleys. Point out that this is accomplished by means of contour lines. State that a contour line represents an imaginary line on the ground connecting all points at the same elevation above sea level. Draw a side view of a hill on the blackboard and draw the contour lines which would indicate elevation of 10 feet, 20 feet, 30 feet, and so on, above the base of the hill. Draw a top view of the hill in which these contour lines appear as irregular circles inside the largest circle which represents the base of the hill. Point out that obviously if the contour lines on the map are close together, it means that there is a very steep slope at that point in the actual terrain, and that when the contour lines are farther apart the slope is proportionately less steep.

205. Use of compass reading.—Point out that it is frequently necessary to use a compass to determine the direction in which to proceed. Explain that in such cases, drivers are usually given a compass reading which they must follow for the prescribed distance. If the compass readings are made accurately, drivers will have little difficulty in reaching their destination. Explain that the reading is for the purpose of selecting a direction of travel at some clockwise angle to the north indication given by the compass. Point out that this angle is measured in degrees. Since there are 360° in a circle, the driver proceeding according to a reading of 90° would actually be proceeding east, or that if the reading were one of 180° he would be proceeding south, etc. Emphasize that when reading a compass, the compass should not be near metal and electrical objects, as these affect its accuracy, and that therefore the driver should get out of the vehicle and stand on the ground.

206. Student practice.—Assign small groups of student drivers to assistant instructors and have student drivers practice drawing symbols, reading maps, orienting themselves to their surroundings by use of the compass and obtaining various readings the assistant instruc-

tors call for. Actual practice in driving to destinations indicated on maps is provided in connection with motor marches, as described in a later section.

E(1)—PURPOSE AND NATURE OF MOTOR MARCHES AND CONVOYS

207. General.—*a. Objective.*—To develop an understanding of the purpose and nature of motor marches and convoys, and to acquaint student drivers with their responsibilities when operating in motor marches and convoys.

b. Place.—Classroom.

c. Teaching aids.—Blackboard; Training Film 11–557.

d. Personnel.—One instructor.

e. References.

FM 25–10, Motor Transport.
TM 10–460, Driver's Manual.

208. Definition of motor march and convoy.—*a.* To introduce the subject, have a showing of Training Film 11–557. Write at the top of the blackboard: MOTOR MARCHES AND CONVOYS.

b. Ask the class the following questions and guide their replies to the suggested answers indicated in parentheses:

(1) What is a motor march? (A motor march is a movement of one or more motor vehicles under a single commanding officer; for example, a company of men moving in vehicles from their camp to a large wooded area for the purpose of carrying out maneuvers.)

(2) What is a convoy? (A convoy is a group of two or more motor vehicles temporarily organized in a motor march for the purpose of transporting troops or supplies that are not a regular part of the motor vehicle units involved. For example, a group of quartermaster trucks assigned to pick up and transport to some destination troops of an infantry regiment.)

Ask the class whether motor marches are carried out only in convoys. Ask them to explain why the answer to this question is in the negative.

209. Differences between driving in a motor column and solo driving.—Ask the question: What skills must drivers use in a motor column to a greater degree than when driving solo? List on the blackboard all replies that are substantially correct. Make sure that the replies cover points such as coordinating speed with speed of other vehicles, maintaining uniform distances between vehicles, following identical routes, obeying specific instructions of commanding officer, etc.

210. Responsibility of the driver.—Emphasize that in a motor march all of these elements are fixed by the column or convoy com-

mander, and that the driver is required to obey the orders of the convoy commander. Point out that, in other respects, the driver is responsible for his vehicle as he would be under ordinary conditions; he is still responsible for its safe operation and for first echelon maintenance. Ask whether driving in a motor march or convoy is made easier because speed of vehicles, distance between vehicles and routes to be taken are decided by the convoy commander. (The answer is that driving in a motor march or convoy is not easier, and in some respects is more difficult.) Ask why this is so.

211. Safety precautions.—Point out that safety precautions should be observed by the driver whether he is driving in a motor march or solo. Explain that the orders of the convoy commander are designed to help the driver maintain his place safely in the column and that only when a military emergency arises will the convoy commander require the driver to assume risks. Stress that the best way to avoid accidents in column is to observe carefully every safety precaution that does not conflict with the orders of the convoy commander.

212. Importance of teamwork in motor marches and convoys.—Emphasize that intelligent cooperation and effective teamwork on the part of all personnel participating in the motor march or convoy is essential. Point out that only in this way can a motor column pass over roads with a maximum of speed and safety and a minimum of interference with other traffic, and arrive at its destination in the best possible condition.

213. Right of way of a small motor march column.—Bring out the fact that a small column containing only a few vehicles ordinarily observes the usual traffic signals and rules of the road. Add that except in an emergency, each vehicle in a small column extends the right of way exactly as individual vehicles do unless the column is accompanied by a military or civilian police escort.

214. Right of way of a large motor march column.—Raise this question: Can a large motor column consisting of many vehicles observe customary precautions as to right of way? In considering the replies of the students, bring out the fact that if a long motor column were to stop for red lights and other traffic signals, the column would soon be scattered. Point out that it is necessary that large motor columns running on a march-order schedule must keep their formation intact and proceed steadily without unscheduled interruptions; that there are various procedures for insuring minimum disruption of large motor march columns.

215. Area control.—Under the words already on the blackboard write: AREA CONTROL. Explain that under this plan the route

and time schedule of the column is furnished in advance to civil and military police authorities.

a. These authorities arrange to divert or block off cross traffic for a distance of several blocks from the motor-march route, if the convoy is large.

b. They arrange to station special police at intersections, or for the column to have green traffic lights throughout the area.

216. Accompanying police.—*a.* Under the words AREA CONTROL write: ACCOMPANYING POLICE. Ask the class what they think accompanying police can do in connection with motor marches.

b. Summarize their replies with the statement that accompanying police are civil or military police on motorcycles or in small cars.

(1) The accompanying police precede a motor column far enough ahead to clear the road and to halt all cross traffic in time to let the head of the column pass safely.

(2) They also watch each intersection until the last vehicle in the column has passed.

217. Guides and guards (or route markers).—Under the words ACCOMPANYING POLICE write: GUIDES AND GUARDS (OR ROUTE MARKERS). Explain that sometimes soldiers are posted from a vehicle which precedes the column in order to block off intersecting traffic and also to indicate the route for the convoy (preferably by means of a marker of some kind). Add that when the column has passed, these men are picked up by the designated vehicles at rear of column which, at the first appropriate halt, proceed to the head of the column and return the men to their place.

218. Right of way in absence of special military orders.—Reemphasize that in the absence of orders to the contrary from the convoy commander the driver must—

a. Obey all local, State, or military traffic regulations, traffic signs, and signals.

b. Drive through a signal-light-controlled intersection only under the following conditions:

(1) When light is green.

(2) When caution light is flashing or fixed yellow.

(3) When a guard (or civil or military police), who is controlling or regulating traffic at the intersection, signals all clear.

(4) When traffic light is not operating.

c. Operate the vehicle at all times at such speed and in such manner that he has proper control over the vehicle.

219. Distances between vehicles in motor march columns.—*a.* Ask the class what factors determine the distance that should be maintained between successive vehicles in motor marching.

b. Make sure that their replies cover the following factors, and list these factors on the blackboard as they are named:

(1) *Speed of movement.*—Point out that if there are no orders to the contrary, it is a good general rule to maintain a distance in yards which is approximately twice the speedometer reading; for example, if the march is moving at 25 miles per hour, each driver should maintain a distance of 50 yards between his vehicle and the one just ahead.

(2) *Driving conditions.*—Point out that in city traffic, where speed is reduced, it is safe for vehicles to be driven fairly close together. Add that if a close distance between vehicles is not maintained under such circumstances, a civilian driver halted at an intersection may get the impression that the column has passed and may attempt to cross the road, with the result that his vehicle may crash into a vehicle which has lagged. Emphasize that close distances are not safe when the column has been ordered to run at a higher speed, because sudden halting or stopping may cause the vehicles to pile up.

(3) *Weather conditions.*—Ask the class why weather conditions are a factor in determining the distance between successive vehicles. (The answers should show that weather conditions determine to a large extent the distance within which a vehicle can be stopped and the distance a driver can see ahead of his vehicle.)

c. Summarize with the statement that the three factors you have discussed should be kept in mind at all times when a fixed distance between vehicles has not been prescribed by the column commander. Emphasize the importance of maintaining any interval that has been prescribed.

220. Judgment of distances.—*a.* Point out that in order to maintain safe distances between successive vehicles in accordance with the orders of the column commander or with the general rules you have just discussed, it is necessary that the driver be able to judge distances well.

b. Ask the class to describe the tricks or devices they have used to judge distances while driving. Point out that it is possible to judge distances by—

(1) Truck lengths.

(2) Spacing of telephone or telegraph poles on the highways.

(3) Noting some small object on the next vehicle ahead and observing that when this object is no longer visible or has decreased considerably in size, the distance between the two vehicles has increased.

c. Remind the class that before they were selected for driver instruction, they had to undergo a test of their eyesight. Point out that their ability to judge distances will depend to some degree on the quality of their eyesight.

221. Road procedures.—Point out and explain why the following road procedures should be observed during motor marches:

a. Drivers should not leave their vehicles unless authorized to do so.

b. Vehicles should not change their position in formation without prior authority, except when falling out as disabled.

c. Disabled vehicles falling out for repairs should fall out to the right of and, if possible, off the traveled portion of the road and wait for the maintenance section. After repairs, they normally remain at the tail of the column until moved up into proper position during a halt by proper authority.

d. Drivers must keep both halted and moving trucks on the right side of the road. This is essential to effective motor marching under ordinary conditions. If this procedure is carefully followed, the driver need have no concern for vehicles other than those in his own column, because other vehicles, both civilian and military, coming up from behind and passing the column can do so without difficulty or interference.

e. In the event of a separation, drivers should observe all traffic signs and signals.

f. Temporary halts are usually made to provide rest for the personnel of the motor march; for checking gasoline, oil, water, and brakes; and for making such mechanical adjustments or corrections as may be needed. It is important that the latter function be carefully performed. Neglect of preventive maintenance by the driver may easily result in interference with one of the most important objectives of motor marches: maintenance of the previously planned time schedule.

g. After a parking area has been assigned, vehicles may be parked in column on the right of the road, but off the road, according to the directions of the convoy commander based on prevailing circumstances. Sufficient clearance should be left between vehicles to allow any vehicle to get out of the column in an emergency. Vehicles parked in column with 6 to 10 feet clearance and wheels turned to the left can make a simultaneous pull-out that will eliminate the possibility of column interruption by civilian traffic. A guard should be placed at the head and rear of the column. Vehicles parked in line

in bivouac areas should be spaced so that there are at least 2 or 3 feet between side rails.

222. Types of marches.—Ask the class whether or not they think all motor marches should be performed in exactly the same way, and ask for some reasons for their answer which should and probably will be in the negative. Now describe in the following manner the various types of motor marches that have been developed to meet varying special conditions, such as when it is desirable to conceal the movement of vehicles from enemy observation or to protect the march from enemy attack.

a. Infiltration.—Write on the blackboard: Type I—INFILTRATION. Explain that in the infiltration type of march, vehicles are sent from concealed areas of assembly, either singly, or a few at a time, at irregular intervals, over a marked route leading to another concealed assembly area. From the air this gradual filtering of vehicles along a road is difficult to distinguish from normal civilian traffic, and even if the enemy recognizes a few vehicles as military vehicles, it is difficult for him to tell how many vehicles are in the march or where they are going. Ask the class what they think is the chief advantage of the infiltration type of motor march. (It provides during daylight as well as at night a fair degree of secrecy because of the small number of vehicles visible at one time.) Ask the class what they think are the disadvantages of the infiltration type of march. (Obviously it requires more time to complete a movement of a motor march column. Another major disadvantage is the possibility of vehicles going astray because of their greater separation from one another. The possibility of drivers getting lost increases considerably at night, especially when driving with lights is forbidden.)

b. Close column.—Under the word INFILTRATION write: Type II—CLOSE COLUMN. Explain that in the close column motor march the available road space is utilized to its maximum capacity. Drivers maintain minimum safe driving distances between vehicles. These distances vary with the speed. Ask the class what they think are the chief advantages of the close column march. (It is easier to maintain control of the column; the column is on the road the shortest possible time; maximum use is made of road capacity and of aircraft protection; short marches can be completed before enemy air units have time to strike.) Ask the class what they think are the chief disadvantages of the close column march. (The strength and type of the organization are visible to enemy aircraft; the

vehicles may arrive faster than they can be concealed, unloaded, or tactically employed; the march provides a profitable target for enemy mechanized forces, artillery or aircraft.)

c. Open column.—Under the words CLOSE COLUMN write: Type III—OPEN COLUMN. Explain that the open column is a compromise between the infiltration and the close column type of march. The column is formed in close marching order at the point of origin. On the road, distances between vehicles are increased considerably, a minimum of 100 yards being prescribed. Ask the class how this compromise method overcomes some of the disadvantages of the infiltration and close column types of marches. (It gets the march to its destination in shorter time than the infiltration method; it permits considerable control; there is little chance of drivers getting lost; and vehicles are spaced far enough apart so that enemy attack will cause a minimum of damage.)

223. Marches in blackouts.—Point out that under certain circumstances at night, especially near the combat zone, it may be necessary for vehicles to move, either alone or in a convoy, without using conventional vehicle lighting equipment. Explain that such blackout driving is necessary to keep the enemy from learning of the movement of vehicles or, if the enemy knows that vehicles are being moved, to keep the enemy from knowing how many vehicles are being moved, their cargo, and their destination, and to secure the protection of darkness against enemy attack.

a. Basic facts about blackout driving.—Emphasize that the following points are of special importance to drivers so far as blackout driving is concerned:

(1) Blackout driving places an unusual strain on the driver and demands constant alertness.

(2) Drivers with poor night vision will be handicapped and should be extremely cautious.

(3) In a blackout, pedestrians on a black-surface road will not be visible at distances greater than 20 to 25 feet from the vehicle.

(4) Drivers must take their driving cues from painted center lines (if these are on a highway), trees, shoulders, curbs, etc. The usual familiar traffic aids will not be visible. On highways the customary signs and markings will probably be partially or completely obscured, and the danger of getting lost will be great.

(5) The danger of accidents (turning over, leaving the road, colliding) is greatly increased.

(6) Vehicles must travel at greatly reduced speeds.

b. Army blackout lights.—Explain that modern military vehicles are equipped with shielded "blackout lights," on both front and rear, which do not illuminate the road and cannot be seen from an airplane higher than 400 feet, but which reveal the position of a vehicle to other vehicles nearby. Point out that Army vehicles are equipped with a light switch which permits the driver to turn on either the conventional lights or the blackout lights. Point out that when the switch is set for blackout driving the conventional stop light as well as other lights is automatically turned off. Explain that the rear blackout light is visible as a single dim glow to the driver 180 or more feet behind, that it appears as two dim points of light at distances between 180 and 60 feet, and that at distances less than 60 feet, four points of light are visible. Explain that the front blackout light appears as a single dim point of light to drivers more than 60 feet away, and that at distances less than 60 feet, two points of light are visible.

c. Temporary blackout expedients.—(1) Point out that some Army vehicles may not be equipped with blackout lights. Describe and have assistant instructor demonstrate some of the ways by which blackout lights can be improvised or vehicles without lights can warn other vehicles of their location:

(*a*) Shielding ordinary headlights and taillights with paper, rags, oilcloth, or other available material so a minimum of light is emitted.

(*b*) Placing reflecting disks on the front and rear of vehicles.

(*c*) Using markers, such as white paint, white paper, or a white handkerchief affixed to the front and rear of vehicles.

(*d*) Careful and sparing use of a flashlight (preferably with its lens covered with colored paper or shielded so that its rays will travel only straight ahead) to warn vehicles not to come too close.

(*e*) Detailing a man to ride in the rear of the vehicle and warn following vehicles of sudden halts or speed changes.

(2) Emphasize again that in blackout driving reduced speed and constant alertness are absolutely necessary for safety.

d. Adaptation of eyes to darkness.—Point out that drivers can see most effectively at night after their eyes have been in total darkness for a period of 15 to 20 minutes. This is because the eyes become "dark adapted." This process of dark adaptation is seriously affected by any light. Drivers should therefore be certain when driving under blackout conditions not to light matches or cigarettes, or to turn on any conventional vehicle lights.

e. Function of assistant driver.—Explain the value of sending a man ahead (assistant driver) carrying a white cloth or handkerchief to increase his visibility, to survey conditions, and report when the driver is in doubt about the road ahead. The driver, with such assistance, should be able to keep the vehicle on the road, follow at the correct distance in column, and observe all the signs and markers that he has been instructed to follow.

E(2)—SIGNALS USED IN MOTOR MARCHES AND CONVOYS

224. General.—*a. Objective.*—To familiarize student drivers with the signals commonly used in motor march operations.

b. Place.—Drill ground or drill hall (classroom if necessary).

c. Personnel.—One instructor.

d. References.

FM 25–10, Motor Transport.
TM 10–460, Driver's Manual.

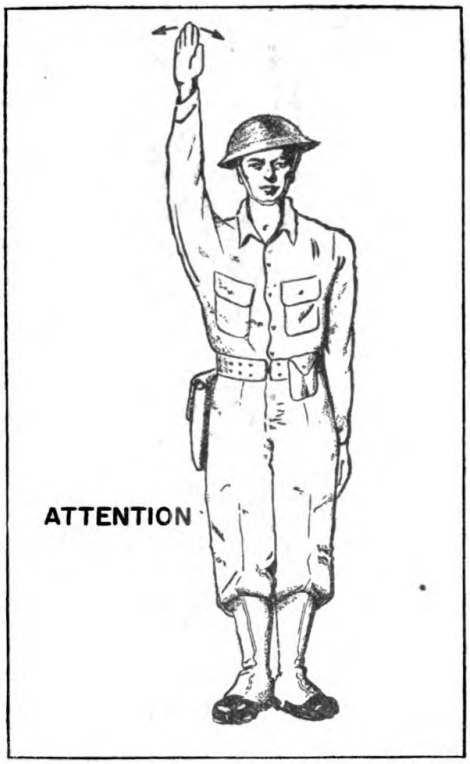
e. Notes to instructor.—Before commencing instruction, be certain that you know all the signals recommended for motor march use, as described in TM 10–460. Assemble student drivers on the drill ground or in the drill hall (classroom, if necessary) with about 2 yards' interval between students. Make sure that all students are able to see you clearly (preferably you should be on a raised platform).

225. Need and purpose of signals.—Explain that it is frequently necessary to use hand signals in giving orders to a motor column. Point out that spoken commands may not be heard by all the drivers in a large motor march because of the din of motors or other noises. State that the hand signals recommended for motor march use will now be demonstrated to and practiced by the students. (See fig. 31 for actual appearance of signals.)

226. Standard signals.—*a. Attention.*—Stand on the platform. Extend right arm full length above the head, palm to front, and move it a few inches slowly from side to side several times. Tell the group that this is the signal for *attention.* Repeat the signal. Have all the students simultaneously execute the signal several times.

b. Start engines.—Explain that the signal to *start engines* is to simulate cranking by describing circles in front of body with the right arm, fist closed. Give this signal twice. Have the entire group give it several times.

c. Ready to start.—(1) Explain that the signal that the driver is *ready to start* is to face the march leader and extend right arm



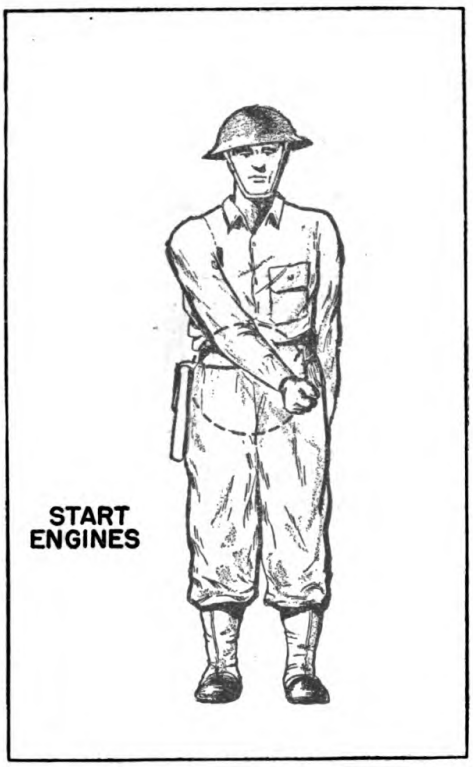
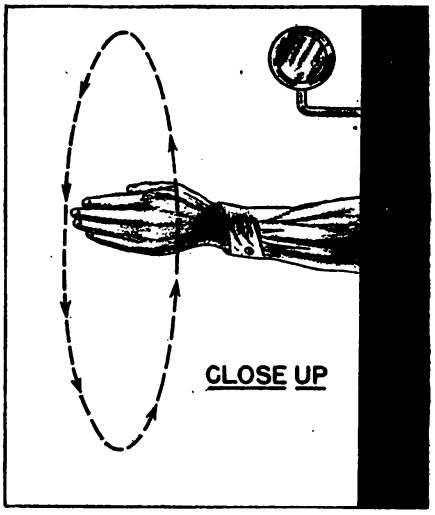


FIGURE 31.—Hand signals used for motor marches.



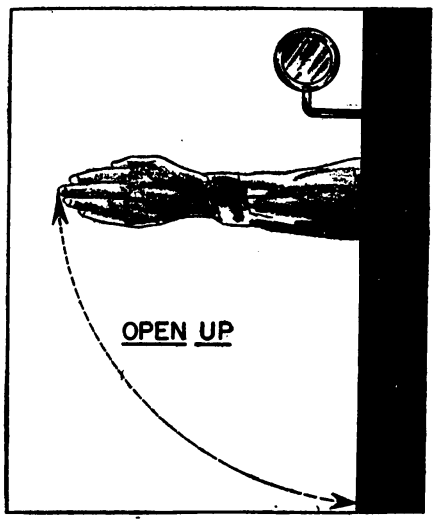


FIGURE 31.—Hand signals used for motor marches.—Continued.

vertically, fingers extended and joined, palm toward the march leader. Give this signal twice. Have all the students give this signal several times.

(2) Call on individual members of the class to give the signals for *attention*, *start engines*, and *ready to start*. Then have the entire group give the signals. Continue practice until the men give the signals without errors.

d. Forward march.—Point out that the signal for *forward march* is to raise arm vertically, palm to front, and lower it to horizontal position in direction of march. Demonstrate twice. Have the group give this signal several times.

e. Stop engines.—Explain to the class that the signal to *stop engines* is to cross straight arms in front of body at waist and move them sharply in arcs upward to the sides, repeating the gesture several times. Demonstrate this signal. Have the students give this signal several times.

f. Decrease speed.—(1) Explain that the signal to *decrease speed* or *stop* is to extend left arm at side at an angle of 45° below the horizontal. Demonstrate twice. Have the entire group give this signal several times.

(2) Continue to demonstrate as necessary and have the entire group practice the signals for *forward march*, *stop engines*, *decrease speed* or *stop*, *start engines*, *ready to start*, and *attention*.

(3) Call on individual members of the class to demonstrate the signals for *forward march*, *stop engines*, *decrease speed*, from memory. Point out and correct all errors. Have the entire group give these signals from memory. Repeat practice until all students can perform these signals without error from memory.

(4) Repeat the same procedure with the signals for *attention*, *ready to start*, and *start engines* until students can perform them without error from memory.

g. Assemble.—Now explain that the signal for *assemble* is to extend right arm vertically, palm front, fingers extended and joined, and move it slowly above the head to describe large horizontal circles. Demonstrate this signal twice. Have the students give this signal several times.

h. Report when ready to start.—Explain that the signal for *report when ready to start* is given by the march leader, and is the same as the signal the driver gives when *ready to start*, that is, to extend right arm vertically, fingers extended and joined. Demonstrate this signal twice. Have the entire group give this signal several times.

i. Increase speed.—Explain that the signal to *increase speed* is to carry closed right fist to shoulder and thrust it upward several times to full extent of arm. Demonstrate twice. Have students give this signal several times.

j. Mount.—(1) Explain that the signal to *mount* is to extend right arm horizontally at side, palm up, and wave it upward several times. Demonstrate twice. Have students give this signal several times.

(2) Now have several students demonstrate from memory the signals to *assemble*, *report when ready to start*, *increase speed*, and *mount*. Point out and correct all errors. Have the entire group repeat these signals until all students can perform them from memory without error. Check student performance of all previously demonstrated signals.

k. Dismount.—Now explain that the signal to *dismount* is to extend right arm horizontally at side palm down and wave it downward. Demonstrate this signal twice. Have students give this signal several times.

l. Close up.—Explain that the signal to *close up*, whether given from the cab or from the ground, is to extend left arm horizontally at side, palm toward the front, and describe a 2-foot circle. Demonstrate twice. Have students give this signal several times.

m. Open up.—(1) Explain that the signal to *open up* whether given from the cab or from the ground, is to extend left arm horizontally at side, palm toward the front, and describe a 90° arc downward several times. Demonstrate twice. Have students give this signal several times.

(2) Have several students demonstrate the signals for *dismount*, *close up*, and *open up*. Have the group repeat these signals until all students can perform them correctly from memory without error.

n. Pass and keep going.—Explain that the signal to *pass and keep going* is to extend left arm horizontally at side and move hand from wrist to describe small circles toward the front. Demonstrate twice. Have students give this signal several times.

o. Turn around simultaneously.—(1) Explain that the signal to *turn around simultaneously* is given by extending both arms horizontally toward drivers and describing small vertical circles, then signaling *forward march* in the desired new direction. Demonstrate twice. Have students give this signal several times. Point out that when given from the cab of a vehicle, the signal to *turn around simultaneously* is to extend left arm downward at a 45° angle, palm toward the front, and describe small circles with the arm. Demonstrate twice. Have students give this signal several times.

(2) Have students repeat signal for *pass and keep going*, and emphasize difference in angle of arm between this signal and signal to *turn around simultaneously.*

(3) Have several students demonstrate signals for *attention, start engine, ready to start, forward march, stop engine, decrease speed, assemble, report when ready to start, increase speed, mount, dismount, close up, open up, pass* and *keep going*, and *turn around simultaneously.* Have the class perform each of these signals simultaneously. Continue practice until students can perform each signal correctly and without hesitation from memory.

p. Immediate danger.—Describe as follows the signal for *immediate danger* (air or mechanized attack) : Three long blasts of a whistle, vehicle horn, siren, or klaxon repeated several times; or three equally spaced shots with rifle, carbine, or pistol, or three short bursts of fire from machine or submachine gun. In daylight point in the direction of the impending danger; at night supplement the alarm by voice warning to indicate the direction of danger. Repeat this description and then call on various individuals to describe this signal to you in detail. Make certain by questioning that all students understand the meaning of all procedures.

227. Signaling under special conditions.—Explain that whenever a march column is halted on a curve on the downgrade of a hill, or wherever some of the drivers cannot see the signals, signals should be relayed along the column or transmitted by messengers to all concerned. Emphasize that the students should know thoroughly not only all of these signals, but also all signals authorized in the manuals of their particular arm of service. Point out that any of the latter signals not in conflict with the ones just practiced may be adopted for use in motor marches.

E(3)—ACTUAL PRACTICE IN MOTOR MARCHES AND CONVOYS

228. Close column driving on practice field.—*a.* Select a reasonably level practice field that will permit group maneuvers and the utilization of the following hand signals: *Assemble, Report when ready to start, Ready to start, Attention, Mount, Start engines, Forward march, Turn around simultaneously, Decrease speed, Stop engines*, and *Dismount.* (The field selected should not present difficulties to drivers and should be free of any conditions which require the use of the low range of the transfer case or of the front-axle drive.) Work out a detailed plan by which you will have the column go through right and left turns, halt simultaneously, turn around and proceed

in another direction, halt, park, and dismount. Select a safe speed-distance ratio for student drivers to observe during practice.

b. Assign an assistant instructor to act as march commander and give him detailed instructions concerning the maneuvers all vehicles will perform and the signals to be used in directing such maneuvers. Have this assistant instructor direct the maneuvers from the leading vehicle in the column. Inform the other assistant instructors that their duty will be to ride with the student drivers and point out and correct errors.

c. Conduct a brief demonstration of motor marching in close column with assistant instructors driving and you commanding, and with student drivers riding beside assistant instructors and observing.

d. (1) Now have assistant instructors change places with student drivers and have the assistant instructor you have delegated to act as march commander assume command. Driving up and down the column in a very light truck or motorcycle, you should watch for and point out the following errors:

(*a*) Failure to maintain prescribed distance between vehicles.

(*b*) Failure to maintain prescribed speed.

(*c*) Uncertainty or error in obeying signals.

(*d*) Delay in executing maneuvers.

(*e*) Failure to follow the vehicle ahead.

(2) Continue this practice, ordering variations in the speeds and distances between vehicles, until student drivers show definite skill in performing the maneuvers.

229. Close column driving on open highway.—*a. General.*— (1) Select a march route that will permit use of all the signals used in motor marches with the exception of the signal for *Immediate danger*. This route should involve various difficulties, such as hills, curves, changes in the road surface, and obstructions to visibility which will make it necessary for drivers to change speed. It should be so laid out that after traversing it, drivers will arrive at or close to the point from which they set out. If it is not difficult enough so that use of the low range of the transfer case or of the front axle drive will be required, select points where drivers will be instructed to use these gears.

(2) Designate an assistant instructor as column commander and give him detailed instructions concerning the signals he is to use in conducting the march over the prescribed route. Proceed with the student practice in exactly the same manner in which practice on the

driving field was conducted. Observe the march from a light truck or motorcycle, watching for and correcting the following errors:

(*a*) Failure to maintain prescribed distance between vehicles.

(*b*) Failure to maintain prescribed speed.

(*c*) Uncertainty or error in obeying signals.

(*d*) Delay in executing maneuvers.

(*e*) Failure to follow the vehicle ahead.

(*f*) Failure to park vehicles at halt in prescribed manner.

(*g*) Failure to dismount on the right-hand side of vehicles and to remain to the right of vehicles at all times during the halt, except during the at-halt inspection.

(*h*) Failure to properly carry out the preventive maintenance schedules.

b. At night.—After student drivers are proficient in close column driving on the open highway in daylight, continue this practice at night with vehicle using lights. (See Unit 4C(2).) Check for the errors listed above, and also check for and correct faulty performance of drivers in meeting and passing oncoming vehicles. (Make sure that drivers follow correct procedure to avoid being blinded by oncoming headlights and be particularly watchful for tendency of any drivers to swerve when approaching and passing oncoming vehicles.)

c. Under blackout conditions.—After student drivers are proficient in night driving using lights, conduct night driving practice with blackout lights. In order to prevent accidents involving civilian vehicles, select a route which is not traveled by such vehicles, or make arrangements to police this route so that civilian drivers will not use it during blackout driving practice. (The most satisfactory route is a back road several miles in length. If you use such a road you can post military police at each end of the road and notify neighboring civilians of the time at which you will conduct blackout driving practice.) Assign student drivers to assistant instructors and have student drivers practice blackout driving on this route, utilizing the safety devices and procedures described in Unit 4E(1). Supervise this practice mounted on an unilluminated motorcycle or light truck. Have assistant instructors make sure that student drivers get practice in using white handkerchiefs or cloths, reflecting disks, etc., as guides to following vehicles, and that they also get practice in riding at the rear of their trucks to warn following vehicles. Watch for improper lights (matches, cigarettes, etc.). If the vehicles are equipped with blackout lights, have assistant instructors check student drivers for their ability to observe proper distances in connection with these lights.

After each trip over the prescribed route, halt the column long enough for drivers to rest their eyes. Continue practice until all drivers are proficient in staying on the road and in maintaining the prescribed distances.

230. Open column driving on an open highway.—Conduct practice in open column driving on the open highway, employing the same procedure used in conducting close column driving practice in daylight. (This practice of open column driving can follow directly after practice in close column driving because of the degree of similarity between the two types of marches.)

231. Close column driving in congested areas.—Follow the same procedure in conducting this practice that was employed in conducting practice in close column driving on the open highway, both in daylight and at night. It is desirable to have practice both with and without area control, accompanying police, guides, and guards.

232. Infiltration driving on open highway, in congested areas, and across country.—*a.* Select a route which will require student drivers to read maps.

b. Install whatever route markers are necessary in advance, and station guides at critical control points.

c. Assemble student drivers at point of departure and emphasize that they must follow their instructions implicitly. Describe in detail the route to be followed, the route numbers to be looked for, and the use they will be required to make of their maps. Ask for questions and clarify all points not clear before starting practice.

d. Have student drivers drive over practice route unaccompanied by any other person in their vehicles. Do not permit assistant instructors stationed along the route to give any directions other than the prescribed signals.

(1) As practice is going on, have assistant instructors record the following:

(*a*) Length of time required for each student driver to reach each critical point, and the ultimate destination.

(*b*) Failure of student drivers to comply with the directions on the route markers or the signals given.

(*c*) Failure of student drivers to maintain prescribed distances between vehicles.

(*d*) Failure of student drivers to follow prescribed route.

(2) After the route has been traversed by all student drivers, assemble them and point out all errors in their performance. Repeat practice until these errors have been eliminated.

F—LOADS AND LOADING; TARPAULINS; ROPE TYING

233. General.—*a. Objective.*—To develop in student drivers an understanding of their duties and responsibilities with regard to loading and protection of cargo.

b. Place.—Field.

c. Personnel.—Loading crew; one assistant instructor.

d. Materials.—One vehicle; various materials to be loaded, such as boxes of various sizes and weights, bales, sacked goods, barrels, crates, long pipes or timbers, planks, etc.

e. References.

Motor Transport School Text No. 16, Military Motor Transportation.
FM 25–10, Motor Transport.
TM 10–460, Driver's Manual.
FM 5–35, Reference Data.
Driver Training Film 11–559.

f. Note to instructor.—It may be deemed desirable to teach rope tying before loading and handling of tarpaulins, since in the latter operations knowledge of rope tying methods may be useful.

234. Driver responsibility for proper loading.—*a. General.*—Assemble student drivers, assistant instructor, loading crew, materials, and demonstration vehicle at loading platform and point out the following:

(1) The driver is not required, in most cases, to do the physical work of loading his vehicle.

(2) However, he is responsible at all times for the proper loading of the vehicle.

(3) There may be times when the loading crew will refuse to load the vehicle in accordance with the driver's instructions. Should this be the case, the driver may formally protest to the officer in charge of the loading crew and also notify his superior at the earliest possible opportunity that such protest was made before the driver hauled the load. By doing these things, the driver will officially disclaim responsibility in the event that the vehicle or load is damaged in transit.

b. Checking on weight of load.—Point out the specific duties of the driver in regard to loading the vehicle. The driver should see to it that the vehicle is never overloaded, unless overloading has been ordered by proper authority. To safeguard against overloading, *he must first know the cargo capacity of his vehicle.* He must therefore ascertain such capacity from the manufacturer's specifications plate

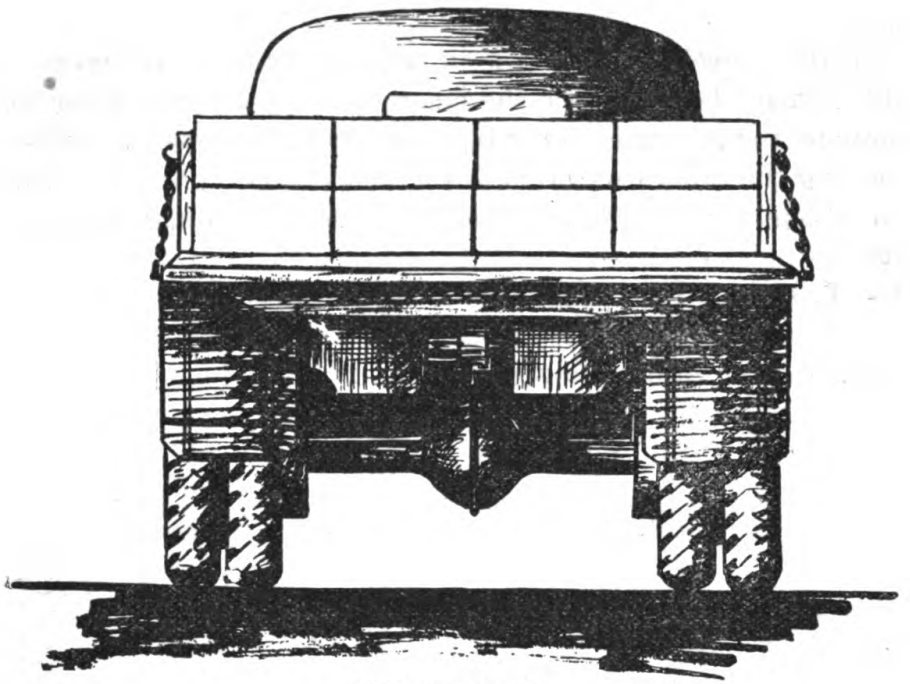
on the vehicle or from his superior. As the vehicle is being loaded, he should estimate or otherwise ascertain the weight of the items being loaded and make sure that the vehicle's maximum capacity is not exceeded and that the load is evenly distributed. There will be many times when the driver will not know the weight of the items being loaded. This does not relieve him of his responsibility. In such case, he should estimate the weight of the load by the extent to which the springs are depressed, and he should know the maximum depth to which each rear spring can be depressed without danger of damaging the vehicle in transit. He can judge this distance by using as a gage a piece of wood marked or sized to indicate the correct height of the frame bumper above the axle when the vehicle is loaded to maximum authorized capacity, and carry this piece of wood in the cab at all times. The driver should see to it that the weight of the load is properly and safely distributed, that the load is secure so that it will not shift or fall off, and is protected from the weather.

235. Manner of loading.—*a. Distributing load.*—The weight of the load should be equally distributed on both sides of the vehicle to prevent broken springs or swaying. Heavy goods should be placed at the bottom and near the front or center of the cargo space. If this is done, there will be less chance of the vehicle overturning, of the load shifting in transit, or of heavy goods damaging lighter goods which may be placed underneath. Loads should not hang over the driver's seat, over the sides of the vehicle, or over the tail gate. (See fig. 32.)

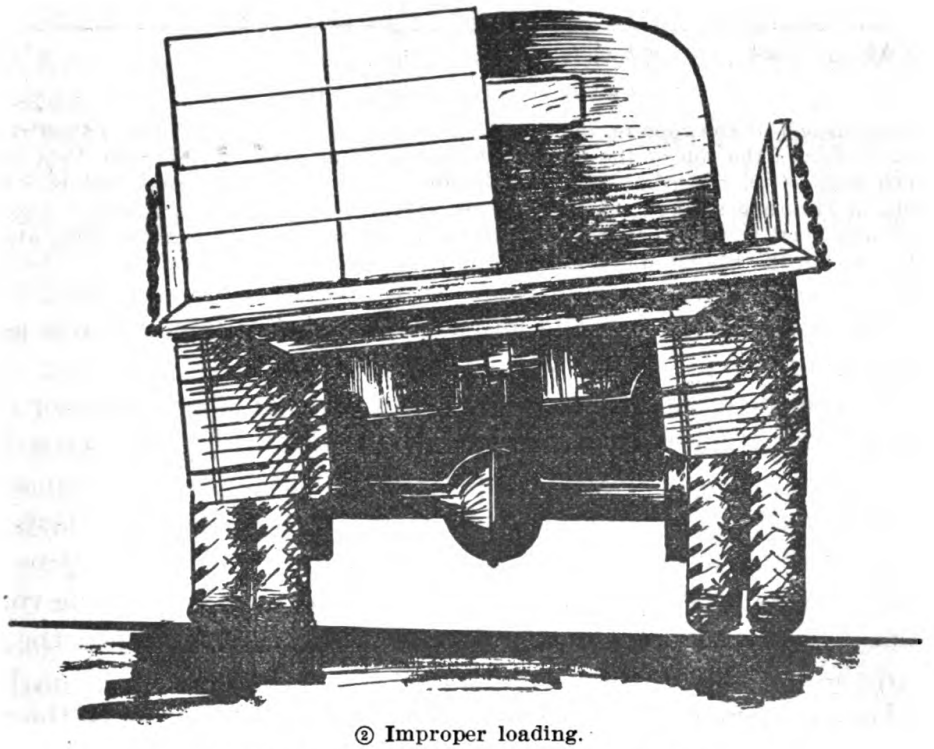
b. Loading long articles.—When it is necessary to load an article longer than the body of the vehicle, a piece of 4- by 4-inch or heavier timber should be placed across the extreme rear end of the truck bed and the tail gate should be lowered so that none of the load rests on it. The end of the long article should be pushed against the front end of the vehicle, on the side opposite the driver if possible, to reduce the chances of injury in case the vehicle is struck from the rear. If it is necessary to load long pieces with the tail gate up, they should be separated in the middle to prevent damage to the tail gate. The end of any long article projecting beyond the rear of the vehicle should be marked with a red flag or a marker.

NOTE.—At this point have loading crew remove long article which they used for demonstration purposes, as you will want to close the tail gate later.

c. Loading barrels.—Barrels which are headed should be loaded on their sides and pyramided. Unheaded barrels should be stood on solid ends and either pyramided horizontally so that they will be wedged in place, or carefully lashed to avoid movement. Sacked



① Proper loading.



② Improper loading.

FIGURE 32.—Proper and improper loading.

goods may be pyramided and tied together by crossing alternate layers of sacks.

d. Loading articles of different sizes.—Articles of various sizes should be loaded so as to tie the entire load together. After loading is complete, the tail gate should be closed as far as possible and secured by hooking the tail gate chains in place. Loads higher than the sides of the vehicle or the tail gate should be securely lashed to prevent falling off.

236. Lashing loads.—Explain that almost all loads should be securely lashed. Point out the two 60-foot ropes used for lashing and the hooks or rings along the sides of the truck, and explain the method

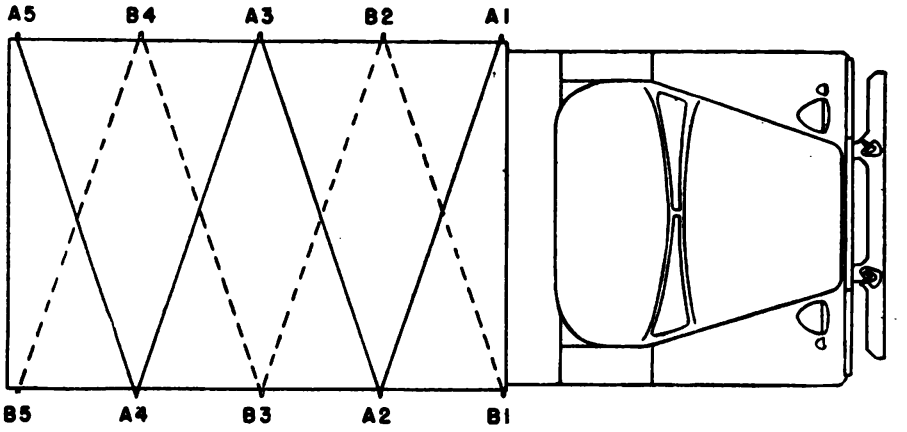


FIGURE 33.—How to lash a load.

Fasten an end of the rope to one of the front lash-hooks or rings (A1). Pass the rope diagonally across the top of the load to the second rope support (A2), and then through the next support on the other side (A3), pulling the rope tight at each support. Fasten the end of the rope securely at the support at the rear of the truck (A5). Using the second rope, start at the other front corner (B1), and repeat the procedure using alternate lash-hooks (B1, B2, B3, B4, and B5).

of lashing the load, while the assistant instructor demonstrates as follows (see fig. 33):

a. Fasten the end of one rope to one of the front lash hooks or rings. Pass the rope diagonally across the top of the load to the second lash hook or ring on opposite side and pull the rope taut. Then pass the rope diagonally back across the top of the load to the third lash hook or ring on the side on which you started and again pull the rope taut. Continue this procedure until you have reached the rear of the vehicle. Fasten the ropes securely in the rearmost lash hook or ring on the same side of the vehicle on which you started.

b. Using a second rope, start at the opposite front corner of the truck and repeat this procedure. When you have finished, if you have per-

formed this operation correctly, the two ropes will criss-cross the top of the load forming a series of diamond-shaped patterns.

237. Special loads.—After student practice in lashing cargo, point out the following to the driver in supervising the loading of—

a. Ammunition.—Under no circumstances should any person smoke while loading a vehicle or in proximity to the vehicle. Extreme care should be taken not to drop any cases. Because ammunition is very heavy, the driver should carefully check and make sure that the vehicle is not overloaded.

b. Gas shells.—When transporting gas shells, the driver should be provided with a gas mask; also with protective ointment for burns.

c. Gasoline.—When transporting gasoline, a chain should be hung from the metal frame of the vehicle to the ground. The driver should watch gasoline containers for leaks and not permit the loading of any containers that are leaking. He should report leaking containers to his superior. Smoking is forbidden.

238. Loading and transporting personnel.—*a.* Point out that when loading and transporting personnel, the driver's responsibility is the same as when loading and transporting materials. He is authorized to warn the passengers to obey the rules for their safe transportation.

b. Point out the following rules for transporting personnel:

(1) Army regulations do not permit the driver to carry more than one person beside him in the cab.

(2) The tail gate should be down when personnel are mounting and dismounting. After personnel are mounted, safety belts should be fastened before vehicle is put in motion. Personnel must mount and dismount only when vehicle is stationary. (See fig. 34.)

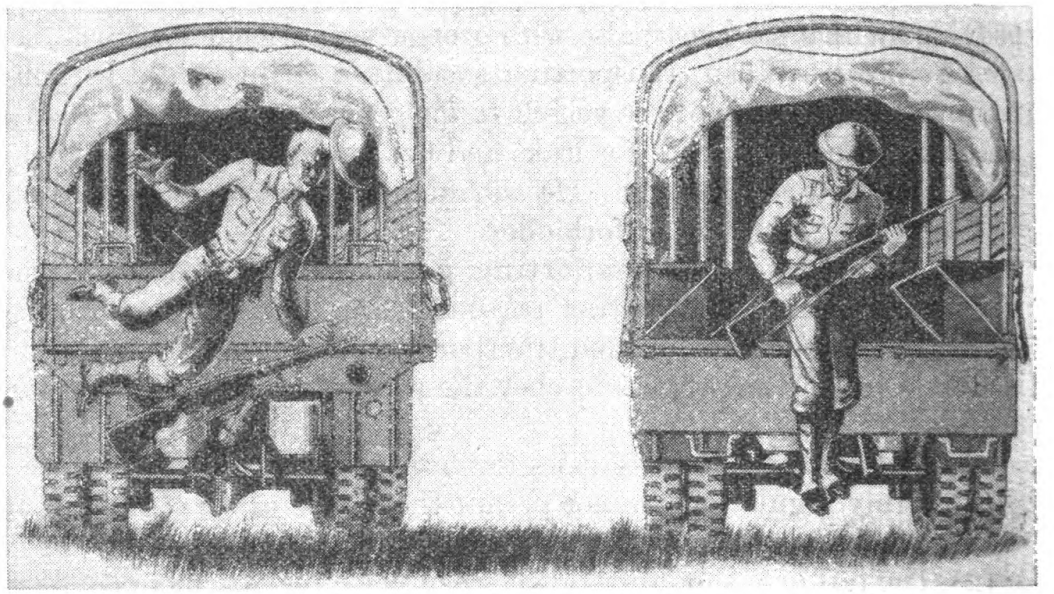
(3) Tail gate must be raised and securely locked before vehicle is put in motion.

(4) Personnel must remain seated while vehicle is in motion.

(5) Personnel must keep all parts of their bodies inside the vehicle while it is in motion.

239. Closed vehicles and carbon monoxide gas.—Point out that the driver can increase the comfort of personnel by fastening a tarpaulin over the top of the vehicle in cold or rainy weather. Regardless of weather conditions, personnel should never be transported in a vehicle which is completely closed because of the danger of asphyxiation from carbon monoxide gas. Point out that carbon monoxide gas is present in the exhaust of all motor vehicles and that, if the muffler or exhaust pipe is not tight, this gas may seep into the cargo compartment.

Carbon monoxide gas gives no advance warning because it cannot be seen, smelled, or tasted in the air. In transporting personnel in a vehicle with a permanent body which can be completely closed, at least one opening should be left, and if the closed body is made by the use of tarpaulins, a section of the tarpaulins, preferably that over the front of the vehicle, should be kept open. Tell drivers that if a soldier is affected by carbon monoxide gas, he should be removed to the open air, artificial respiration administered, and medical assistance summoned.



① Tail gate up; soldier down and out; one more casualty. ② Tail gate down; troops dismount safely.

FIGURE 34.—Position of tail gate for dismounting.

240. Purpose of tarpaulins.—Assemble student drivers about a vehicle equipped with tarpaulin (rolled down) and point out that tarpaulins are used to protect cargo or passengers from bad weather, dust, and sand. Explain that when transporting personnel in warm weather, tarpaulins may be rolled up at the discretion of the officer in charge.

241. Folding up tarpaulins.—*a.* When folding up tarpaulins, they must be folded evenly and fastened tightly; uneven folding will cause the canvas to crack, and poor tightening will permit the tarpaulin to flap and tear.

b. Have two assistant instructors demonstrate folding up a tarpaulin while you explain as follows:

(1) Loosen tie ropes.

(2) Fold bottom of tarpaulin up 6 to 8 inches, making sure that the fold is even and that there are no wrinkles.

(3) Continue to fold tarpaulin until straps and bows are entirely exposed.

(4) Fasten straps to tarpaulin, using buckles and bows and making sure that all fastenings are tight.

(5) Tie end ropes to front and rear bows in such a manner that the ropes will not hang loosely.

(6) Ropes should come down on outside of bow, not on inside, so that troop seat can be fastened up.

c. Now have student drivers practice folding up tarpaulins while assistant instructors assist and supervise. Continue this practice until all student drivers are proficient.

242. Folding tarpaulin down and securing.—Have an assistant instructor demonstrate method of folding tarpaulin down and securing as follows:

a. Untie end ropes.

b. Unbuckle straps.

c. Unfold canvas.

d. Fasten end ropes securely, using half hitches described in paragraph 264.

e. Fasten all tie ropes tightly, using half hitches, making sure that tarpaulin hangs evenly on both sides of vehicle.

243. Removing tarpaulin and folding.—*a.* Have two assistant instructors demonstrate removing the tarpaulin from the vehicle and folding it, while you explain as follows:

(1) Be sure that in removing the tarpaulin the canvas will not be torn on any sharp metal parts or jagged wood on the vehicle. Be sure that you have available a clean area of ground for folding the tarpaulin.

(2) Loosen all tie ropes.

(3) Pull tarpaulin to the ground, making sure that it falls on the clean area you have selected.

(4) Spread canvas flat on the ground and make sure that there are no turned-in corners or wrinkles.

(5) Turn in all tie ropes except the two end ropes at one end.

(6) Do not fold in the two end ropes you have left exposed until the proper time.

(7) Fold sides of tarpaulin into the seams.

(8) Fold sides into the center.

(9) Fold in half.

(10) *Mark canvas to show which end is front.*

(11) Fold each end in about 18 inches.

(12) Continue folding ends in, leaving a space of about 6 inches in the center when you have completed the folds.

(13) Tie end ropes in such a manner that crosses are formed on the top and bottom of the folded canvas.

b. Now have student drivers under the supervision of assistant instructors practice removing and folding tarpaulins until proficient.

244. Placing tarpaulin on vehicle.—*a.* Now have an assistant instructor demonstrate placing a tarpaulin on a vehicle while you explain as follows:

(1) Select a clean area of ground and place tarpaulin on the ground.

(2) Untie end ropes.

(3) Unfold toward the ends. Do not unfold to the sides at this time.

(4) Determine from your marking which end should be placed at the front.

(5) Place tarpaulin on top of the bows of the vehicle, with closed side of folded canvas extending along the center of the bows.

(6) Unfold sides of canvas downward.

(7) Tie end ropes securely.

(8) Tie all tie ropes very tightly, using half hitches, making sure that the tarpaulin hangs evenly on both sides of the vehicle.

b. Now assign student drivers to assistant instructors and have them practice installing tarpaulins until proficient. Try to conduct practice in installing, removing, and stowing as many types of vehicle covers as are available.

245. Rope tying.—Assemble student drivers in front of a vehicle or, if weather is bad, in the classroom, and pass out one 10-foot length of 1-inch manila rope to each four students. Explain that you are about to demonstrate the tying of various knots which they may find useful on many occasions, not only in connection with loading. Point out that it is desirable for the driver to know not only how to tie several kinds of knots but also which knot to use for any specified job. Add that because it will often be necessary for drivers to tie knots in the dark, drivers should become so familiar with the knots you will demonstrate that they can tie them by using the sense of touch alone. Now demonstrate two or three times how to tie the first of the knots listed below and at the same time describe its purpose or use. Then have students practice tying that knot. Correct any errors that come to your attention as you supervise

the group. Then have each student check the work of his neighbor and point out any errors. When general proficiency seems to have been attained, call on several students to state the purpose or use of the knot practiced. Follow the same procedure in the case of each of the knots described in paragraph 246.

246. Types of hitches and their uses.—*a. Bowline.*—To form a loop that will not slip, make loop with standing part underneath, pass end from below through loop, over the part, around the standing part, then down through the loop. (See fig. 35①.)

b. Square or reef.—To join two ropes of same size, pass standing and running parts of each rope through loop of the other in same direction. Ends of each rope are led around end of other. (See fig. 35②.)

c. Carrick bend.—Used to fasten guys to derrick or A-frame legs. (See fig. 35③.)

d. Clove hitch.—Used to fasten a rope at right angles to a spar or at beginning of lashing. (See fig. 35④.) If end of spar is free, the hitch is made by first forming one loop and placing a right-hand loop over the first. Slip double loop over end of spar. Otherwise, pass end of rope around spar, bring it up to the right of standing part, cross over latter, make another turn around spar, bring up the end between spar, last turn, and standing part.

e. Timber hitch.—Used to haul or lift spars. (See fig. 35⑤.) This hitch can be loosened easily when strain is taken off, but will not slip under load. When used for hauling spars, a half hitch is added near end of spar.

f. Sheepshank.—Used to shorten a rope or pass a weak spot, take a half hitch with the standing parts around the bites. (See fig. 35⑥.)

g. Blackwall hitch.—Used to attach a single rope to a hook of a block for hoisting. (See fig. 35⑦.)

h. Two half hitches.—Used to belay or make fast end of rope around own standing part. (See fig. 35⑧.) End may be lashed down or seized to standing part to prevent slipping.

G—DRIVER'S TRIP TICKET AND PERFORMANCE RECORD, DRIVER'S ACCIDENT REPORT, AND MOTOR VEHICLE OPERATOR'S PERMIT

247. General.—*a. Objective.*—To familiarize student drivers with the purpose and use of Driver's Trip Ticket and Performance Record, Driver's Accident Report, and Motor Vehicle Operator's Permit.

b. Place.—Classroom.

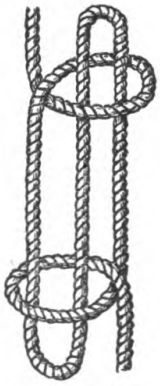
① Bowline.

② Square or reef.

③ Carrick bend.

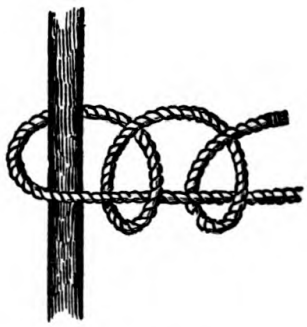
④ Clove hitch.

⑤ Timber hitch.



⑥ Sheepshank.

⑦ Blackwall hitch.



⑧ Two half hitches.

FIGURE 35.—Types of hitches.

c. Materials.—One copy for each student driver: Driver's Trip Ticket and Performance Record, Driver's Accident Report, and Motor Vehicle Operator's Permit.

d. Reference.—TM 10–460, Driver's Manual.

248. Trip ticket and performance record.—Assemble student drivers in classroom. Point out that you have already referred at various times to the Driver's Trip Ticket and Performance Record. Pass out copies of Driver's Trip Ticket and Performance Record to student drivers, and discuss each item on this form. Make sure that drivers understand the way in which they are to fill out all items especially assigned to them, and point out those items which are not to be filled in by the driver. Emphasize the importance of having the form properly signed.

249. Accident report.—Pass out copies of Driver's Accident Report (Standard Form No. 26) to student drivers, and discuss each item on the form. Use sample Driver's Accident Report (fig. 49) as a guide in detailing the information that should be given. Emphasize the importance of filling out this form in its entirety, and returning it as soon as possible after an accident. Stress also the importance of getting the names of witnesses and giving full and correct details concerning the accident. Point out that the Driver's Accident Report form should be kept in the vehicle at all times, and that drivers, before starting on any trip, should make sure that they have one of these forms.

250. Operator's permit.—Pass out copies of the Motor Vehicle Operator's Permit (W. D., Q. M. C. Form No. 228) to student drivers and point out that these fulfill the same purpose in the case of military vehicle operators as the driver's license does in the case of civilian drivers. Emphasize that these permits are evidence of faith on the part of the Army that the driver is competent to handle various types of vehicles, and that all drivers should endeavor to justify the confidence the Army has placed in them. Point out that the driver may operate only those types of vehicles which are specified on the Motor Vehicle Operator's Permit. Call attention to the provision made on these permits for recording accidents and stress the fact that the permit will be immediately revoked when an accident or other cause so warrants. After answering all questions concerning these forms, point out that when the students complete the course and pass their examination, they will receive a Motor Vehicle Operator's Permit.

H—DIFFICULT DRIVING

251. General.—*a. Objective.*—To develop in student drivers competence in operating their vehicles on considerably difficult terrain, using chains and traction devices if required; to develop in drivers the ability to make proper decisions and carry them out successfully; and to insure, so far as possible, that drivers will "get through" under difficult circumstances.

b. Place.—On difficult driving range. The selection of locations for the carrying out of demonstration and practice will largely depend on the facilities available, therefore the instructor must exercise all his ingenuity in selecting proper locations insuring that practice in each of the difficult operations proceed from simple situations, in which the driver may reasonably be expected to get through without much difficulty, to extremely difficult situations in which the vehicle will often get stuck unless the driver uses a great deal of skill.

c. Note to instructor.—Each situation should be such that the use of the winch, block and tackle, and manual assistance will not be required. After practice in moderately difficult driving situations, the student drivers will be taught the operation of the winch and other devices for rescuing badly stuck vehicles. Then give them actual practice in the field in the use of this equipment. Such practice should be undertaken under extremely difficult circumstances.

d. Equipment.—Sufficient number of vehicles to enable all drivers to get necessary amount of practice in available time; pioneer tool equipment; ropes, chains, and traction devices; materials available in the field, such as logs, planks, rocks, brush, etc.

e. Teaching aids.—Training Film 11-554.

f. Personnel.—If available, one assistant instructor for each vehicle.

g. References.

FM 25-10, Motor Transport.
Motor Transport School Text No. 16, Military Motor Transportation.
TM 10-460, Driver's Manual.
TM 10-1147, Maintenance Manual GMC 2½-ton 6 x 6.
TM 31-200, Care and Maintenance of Pneumatic Tires and Rubber Treads.
Specifications of Manufacturers of Chains and Traction Devices.

252. Introductory remarks.—Assemble student drivers, assistant instructors, and vehicles in the field and briefly discuss the following:

a. Explain that when driving close to the front, plenty of clear thinking and good judgment are necessary both to keeping out of trouble and to getting out of trouble.

b. Point out the difference between driving close to the front, both cross-country and on roads, and driving well back from the front, as follows:

(1) Even though roads well behind the front may have been bombed or shelled, they are usually repaired quickly so that driving on them will not be too difficult.

(2) Close to the front, however, roads may be badly battered, may be insufficient to handle the volume of traffic so that cross-country driving is necessary, or may be subject to bombardment by the enemy, in which case cross-country driving may again be necessary.

(3) Near the front, vehicles are often dispatched singly or in small groups and drivers under such circumstances are often "on their own."

(4) When transport vehicles are operated close to the front, the need for getting cargo through to its destination is urgent.

(5) Soldiers at the front or moving up to the front will need ammunition and food; tanks will need fuel; medical supplies must reach field hospitals; if the driver does not get through, many men may die and positions may be lost that can only be regained at the cost of many more lives and tremendous quantities of material.

c. Stress again that driving close to the front is the greatest responsibility the driver can face because he is called upon to give the best that is in him, both physically and mentally, because he must not fail to get there on time, with his vehicle and cargo intact, and because if he fails, it may be too late or impossible to send a second vehicle. At this point, if possible, have a showing of Training Film 11–554 to give the students an overview of difficult driving problems and practices.

253. Reconnaissance.—*a.* Explain that the best means by which the driver can insure getting through a difficult situation successfully is to make a careful reconnaissance.

b. Point out that in making the reconnaissance the driver should consider the following:

(1) The traction devices on his vehicle, the winch, if the vehicle is equipped with one, the pioneer tools in his vehicle, ropes, chains, block and tackle, if he has them, and also the resources of the vicinity, such as lumber, logs, stones, and other materials.

(2) Manual assistance available from other soldiers or civilians.

(3) Whether or not other vehicles are in the vicinity and in a position to assist him.

(4) The difficulties throughout the entire distance the vehicle must travel before reaching a road or a ground surface that will permit him to proceed safely.

c. Emphasize that it is a more soldierly procedure to first make a careful survey of the situation and drive ahead, only after it appears reasonably possible to keep going rather than to plunge ahead without a preliminary survey.

d. Quote the following from TM 10–460, paragraph 79: "Some men get the idea that because war involves dangerous acts, it is 'smart' to be reckless all the time under war conditions. Quite to the contrary, the more we suffer by enemy action, and the more we are compelled to take risks, the more we need to avoid losing men and property through carelessness or recklessness. A hero takes risks when he hopes to gain a worthy objective; only a fool takes risks needlessly."

254. Pioneer tool equipment.—Assemble student drivers and assistant instructors about a vehicle and explain the pioneer tool equipment to them as follows:

a. Describe the purpose and use of each tool. (Example: In calling attention to the ax, point out that the ax may be used to clear away underbrush and trees, to fell timbers for bridging boggy places and ditches, and for reinforcing bridges, etc.)

b. Explain that actual practice in the use of pioneer tools will not be undertaken at this time, because tools will get plenty of use as drivers learn how to overcome difficult driving situations.

c. Mention briefly the winches and block and tackle, and explain that instruction in their use will be given later in the course.

255. Chains.—Assemble student drivers, assistant instructors, and vehicles in a field at a point where there is a stretch of muddy terrian sufficiently difficult to negotiate so that student drivers will get a good practical demonstration of the use of these aids to traction in heavy going.

a. Use of chains.—Explain that chains are used to give added traction on slippery roads, in deep sand, snow, mud, and boggy ground. Have an assistant instructor lay out a set of chains on the ground and let student drivers examine them briefly. At the same time, explain and have assistant instructor demonstrate the operation of the side-chain locks. Point out that chains should only be used when actually negotiating a difficult situation, and that they should be removed as soon as the difficult stretch of road or terrain is crossed.

b. Keeping chains clean.—Stress that it is the responsibility of the driver to keep chains clean, oiled, free from rust, and properly adjusted at all times. Emphasize that chains, while they provide additional traction, are of little or no help in preventing skids and that drivers should guard against a false feeling of confidence when driving with chains on an icy or otherwise slippery surface.

c. Unnecessary use of chains.—Emphasize that chains should be used only when absolutely necessary, because use of chains causes excessive wear of both tires and chains, particularly if the vehicle is driven on a hard surface. State that driving a vehicle only a few miles on a hard road with tires equipped with chains may ruin both the set of tires and the chains.

d. Putting on chains.—Have one assistant instructor demonstrate the proper method of applying chains on front wheels while you explain each step, as follows:

(1) Chains should be laid out flat on the ground in front of each front wheel to be fitted with chains, in the line of travel of the vehicle, so that when the vehicle is driven forward the wheels will drive into the chains. Drivers should make sure that chains are laid out with the open ends of the cross-chain connecting links on the ground. The side-chain clasps should be to the rear, otherwise the chains may loosen or come off.

(2) The driver should then get into his vehicle and drive ahead to a point where each wheel will rest on about the middle section of each chain.

(3) The driver should then dismount and fasten the chains by lifting the front end of each chain over and around the wheel and lifting the rear end of each chain over and around the wheel and locking the side-chain clasps. Point out that in applying chains on rear wheels, a similar procedure is followed, except that the chains are laid out to the rear of each wheel and the vehicle is backed onto them. Point out that chains must be fitted loosely enough so that they will be able to "creep" on the tires, yet tightly enough so that they will not strike the vehicle body or be pulled off in heavy driving. Point out that chains should be installed before driving into the difficult terrain. Emphasize that it is extremely difficult and may take a great deal of time to try to put on chains *after* a vehicle has become mired. As you have been making this explanation, the assistant instructor has been demonstrating the method of installing chains. Now have assistant instructor remove chains and stow them away while student drivers observe.

(4) Assign student drivers and vehicles equipped with chains to assistant instructors and have student drivers perform the operations of putting on and removing chains under the supervision of assistant instructors until they can perform these operations proficiently.

e. Number of chains and selection of wheels.—Reassemble student drivers and point out the following: If there are not enough chains to be used on all driving wheels, chains must be omitted on one or more pairs of driving wheels on the same axle. This is necessary because if there is a chain on one wheel and no chain on the opposite wheel on the same axle, the differential will divert the power of the engine to the wheel without the chain, making it spin, and no power will be delivered to the wheel with the chain; for example, if there are six driving wheels, four in the rear and two in the front, and there are only five chains, four chains only should be used on the four rear driving wheels, or on a pair of the four rear driving wheels and on the two front driving wheels. Add that if the driver has only one chain for a wheel with dual tires, he should install that chain on the outside tire. Ask for questions and explain any points not clear.

f. Demonstration.—Have an assistant instructor get into a vehicle not equipped with chains, drive into boggy ground, and halt the vehicle as if stuck. It is not necessary for the vehicle actually to get stuck. However, the going should be difficult enough so that the student drivers will get a realistic demonstration of the use of chains. Have another assistant instructor apply chains on a second vehicle and drive across the difficult section. Ask student drivers what the driver on the stuck vehicle can do to get his vehicle out of the mire. There will be a number of answers, and at this point explain that various aids other than chains will be discussed and practice in their use given later in the course.

256. Use of rope in place of chains.—*a.* Point out that you are going to have the assistant instructor (in stuck vehicle) demonstrate a way in which he can improvise a substitute for chains to get him out of his difficulty. Explain that to improvise this substitute, he must either have with him or be able to get from somewhere in the vicinity a piece of ½-inch or larger rope.

b. Explain that the rope must be looped around sections of the tires on at least two driving wheels and secured with a square knot. Point out that the amount of traction gained by use of a rope as an improvised chain is actually determined by the thickness of the rope and not so much by the number of sections of rope fastened to each wheel; that is, that one loop of 1-inch rope around a tire will give more traction than two loops of ½-inch rope. State that if the driver has a fairly

long section of ½-inch rope, he should make several turns of this rope around the tire in the same place. When he has used up about half the rope, he should make several turns around a section of the tire on the opposite driving wheel on the same axle. Add that if he has a very long rope, he may duplicate this process several times and on more than one pair of driving wheels. Explain that the purpose is to get increased traction on at least one pair of driving wheels.

c. Have assistant instructor in charge of mired vehicle cut up the length of 1-inch rope, secure it around two or more driving wheels, and then drive the vehicle out of the mire. Explain that the use of rope as a substitute for chains is always an emergency expedient and that in emergencies it is largely up to the driver to figure out the best way of getting out of the particular situation.

d. You may at this time have student drivers practice putting on chains and removing them. You must bear in mind that they will have considerable practice in the use of chains later in the course, and that at this point, it is sufficient merely to instruct them in applying and removing chains.

257. Traction devices.—Assemble student drivers in the field about demonstration vehicles and lay out on the ground one complete set of each type of traction device available.

a. Purpose.—Explain to student drivers that the function of traction devices is to provide a track on which the driving wheels of the vehicle can run; that because this track provides a much larger surface of contact with the ground than is provided by the tires, it distributes the weight of the vehicle over a proportionately greater surface so that the vehicle is able to negotiate mud, snow, heavy sand, deep sand, and other rough terrain which it could not otherwise manage.

b. Description.—Direct attention of student drivers to the grousers on the shoes of traction devices and point out that they grip the ground surface and provide a high degree of traction as the vehicle is driven forward or backward. Point out the row of shoes or tracks which are joined together by locking bands and secured by bolts. State that in some types of traction devices each shoe is a detachable unit and that with this type the driver may lengthen or shorten the track to any desired length. Add that in other types of traction devices several shoes may be bound together in one section. Mention that in both types provision is made for adjusting the entire section of track so that it will fit the wheel or wheels on which it is to be used. This adjustment is made by turning screws on the adjustable shoes.

c. Guide blocks.—Point out the guide blocks on each shoe and explain that these guide blocks fit snugly between the tires of dual wheels

and keep the traction devices from slipping off the wheels. Tell the students that obviously traction devices can be used only on dual wheels. Mention that if it is necessary to use traction devices on front wheels which are not dual wheels, such wheels must be made into dual wheels by bolting spare wheels to the single wheels.

d. Adjusting length of track.—Have an assistant instructor demonstrate the method of adjusting the length of sections of track on all the types of traction devices available. Have assistant instructor demonstrate the method of shortening or lengthening track by removing or adding one or more shoes. Have student drivers practice adjusting the length of track and removing and adding sections of track until this is done proficiently. Ask for questions and clarify all points not clear.

e. Application on dual wheels.—Explain that traction devices should always be applied on both dual wheels of any single driving axle because, if this is not done, the dual wheel without the traction device will spin and no power will be delivered to the dual wheel that is equipped with the traction device. Add that if it is desired to equip the four dual wheels on bogie axles with traction devices, traction devices may be fitted to each of the four dual wheels separately or they may be lengthened so that the corresponding pairs of dual wheels on the right- and left-hand side of the vehicle will each run on a single long track.

f. Conversion into a half-track vehicle.—Point out that this last method actually converts the vehicle into a half-track vehicle with the result that its performance is similar to that of a tractor equipped with caterpillar driving tracks. Indicate that by this method there is a greater distribution of the vehicle's weight on the ground than would be the case if traction devices were applied singly to the four rear driving wheels. Ask why this is so. (Weight is placed on the section of track in contact with the ground between both sets of forward and rear driving wheels driven from the bogie axles.) Explain that if two men are available, it is not difficult to apply traction devices by having one man drive and the other actually put on the devices. Add that in an emergency it is possible for one driver alone to apply the devices by driving the vehicle ahead a few inches at a time, stopping and getting out and manhandling the track around the wheels.

g. Steps in applying traction devices.—Explain that in applying traction devices the easiest procedure is as follows (have two assistant instructors, one driving the vehicle and the other applying the traction devices, demonstrate as you explain):

(1) Check the tightness of all connections between shoes and make sure that the section of track for each wheel or set of wheels is adjusted to the proper length.

(2) Lay out one section of track on the ground behind one dual wheel or pair of dual wheels on bogie axles in the line of travel of the vehicle. Drive vehicle slowly backward onto track, making sure that the guide blocks fit between the tires on the dual wheel or wheels.

(3) After the wheel or wheels have passed over two or three shoes, lift up the first shoe and hold it against the rotating tires of the wheel, allowing the motion of the wheel to wind the track around the tires. Emphasize that obviously, if the track is to be placed on a pair of dual wheels on the same side of the bogie axles, the vehicle must be driven backward until the foremost wheel has passed over two or three sections of track before front end of track is lifted and held against the foremost tires.

(4) Continue driving vehicle slowly backward until track has been guided by hand over the top of wheel or wheels to a point where the first shoe is hanging down in a position where it can be conveniently locked to the last shoe.

(5) Lock first and last shoes together, making a continuous track.

(6) Check to see that there is no sag in the track. (If necessary, tighten the track in accordance with the specifications of the manufacturer of the traction devices.) Mention that too tight a track causes loss of power and wear on tires and traction device. Have assistant instructors continue installing traction devices on all driving wheels (driving vehicle ahead to install devices on front wheels). Ask for questions and clarify any points not clear.

h. Removing traction devices.—Have assistant instructors demonstrate method of removing traction devices, and any short-cut methods for removing them so that time may be saved in an emergency. (On some types of traction devices, the device may be removed merely by unfastening the connecting bolt and driving the vehicle off the device.)

i. Installing and removing traction devices.—Assign student drivers to assistant instructors and have them practice installing and removing traction devices until proficient. At the same time, have assistant instructors point out and correct all errors. If facilities are available, make sure that student drivers practice installing tracks on single dual wheels and on bogie dual wheels. Explain that after traction devices have been properly adjusted so that they fit the wheels, no further adjustment is necessary unless, after some driving, it is found that slack has to be taken up. Point out that the length

of tracks will usually have to be readjusted when wheels are fitted with new tires.

j. Maintenance of traction devices.—Emphasize that it is the driver's responsibility to keep traction devices clean of mud, to keep the threads on nuts and bolts oiled and to stow traction devices properly after use. Have assistant instructors demonstrate method of cleaning and oiling traction devices and method of stowage. Have student drivers clean and oil traction devices and stow them away. Explain that practice in the use of traction devices under difficult driving situations will not be undertaken at this time, but student drivers are being instructed now in the application of traction devices so as to make them familiar with the use of these aids when they get into situations where traction devices are necessary.

k. When to apply traction devices.—Emphasize strongly that traction devices must be applied before entering upon a stretch of boggy ground, mud, snow, sand, etc., and add that once the vehicle is stuck, traction devices cannot be applied. Stress that the driver must always make sure before entering difficult ground whether or not traction devices will be needed.

258. Leaving road and crossing ditches.—Assemble drivers, vehicles, and assistant instructors at a place where they may drive off the road without too much difficulty, and beyond which there is a ditch that is not too deep or boggy.

a. Explain that leaving the road is the first difficult situation to be taken up because obviously it is the first problem the driver will have to face when it becomes no longer possible to drive on the highway. Explain that when drivers are compelled to leave the road, naturally the first decision they must make is to select the best place to drive off the road.

b. Have drivers make a reconnaissance at the point you have selected, keeping the following in mind:

(1) That it does no good to drive off the road successfully and then have to back on to it again after covering only a few feet.

(2) That reconnaissance should cover the entire distance to be traversed off the road and should never be limited to the first few feet or yards.

(3) That if the entire cross-country stretch cannot be traversed successfully with the aid and equipment available, drivers must not attempt to leave the road but should inform their superior officer.

(4) That the place selected for leaving the road is the best in the vicinity.

c. After drivers have made the reconnaissance, find out by questioning what they have learned from such reconnaissance. Find out what they believe is the best method of driving off the road at the point you have selected and getting back on the highway at the selected return point.

d. Point out that deep or boggy ditches may be made negotiable by filling them with whatever material is available, such as rocks, dry soil, logs, planks, etc. (At this point you may have a certain amount of pioneer work, such as just described, performed by student drivers.)

e. Ask if there are any obstructions in the ditch which will strike and possibly damage the front axle, steering connections, and radiator. The answer will be "No," but stress that pioneer work must be performed if such conditions exist.

f. Emphasize that military vehicles are equipped with tremendous power and that the next step for the driver is to select the gear ratios (including whether or not the transfer case low shift lever or front-axle lever will be used) to be used for the entire crossing. Stress that the gear ratios should be the lowest necessary to negotiate the difficulty without straining the engine.

g. Briefly discuss the following points which are helpful when crossing ditches and shell holes:

(1) Small and shallow ditches can be most easily crossed at an angle to the ditch so that only one or two wheels are in the ditch at the same time. Deeper ditches should be crossed whenever possible at a right angle so that both front wheels will enter the ditch at the same time.

(2) Stress that this is particularly important when the front wheels must climb a steep slope to leave the ditch, because if one wheel is in advance of the other, greater pressure will be placed upon the forward wheel, with the result that it will either refuse to obey the steering wheel and turn to the right or left, making progress impossible, or damage will result.

(3) Ditches should be crossed at a steady, even pace, basing the speed on the lowest speed necessary to negotiate the most difficult portion of the crossing without straining the vehicle.

(4) Emphasize that when several vehicles are crossing a ditch the fact that one vehicle has just crossed successfully is no reason for assuming that the next will be able to do so.

(5) Point out that if several vehicles cross, the ditch may be deepened to the extent that new material must be filled in. Also that all vehicles do not have the same power or traction.

(6) Stress that the driver of each vehicle, whether following other vehicles or not, should survey each situation from the standpoint of his own vehicle, the present physical condition of the ditch, and his own driving ability. Explain that although at this time drivers are about to cross a ditch and not a shell hole, the difficulties are much the same. Point out that if it is not possible to drive around holes in the road they must either be filled or graded so that the vehicle can negotiate the slopes, or they must be bridged. Mention as a matter of interest that in crossing recently shelled areas drivers must be on the alert for mustard gas which lingers in depressions for a considerable time and which may be picked up by vehicles and cause casualties if touched later. Have an assistant instructor drive across the ditch and return to the road at the selected point. Ask student drivers for comments and answer all questions. Now tell student drivers the gear ratio in which they will cross the ditch, the angle at which they should cross, etc. Have student drivers drive across the ditch, one at a time, return to the road and park on the right-hand side well out of the way of all traffic. Assemble student drivers and ask assistant instructors what errors they have noticed. Explain these errors for the benefit of all assembled. Have practice repeated until all students are proficient in crossing the ditch. Repeat on more difficult ditches (boggy, sandy, deep, etc.) using chains and pioneer tool equipment as required until student drivers are proficient.

259. Crossing boggy ground.—Assemble student drivers, vehicles, and assistant instructors at a point where there is a stretch of boggy ground which is sufficiently firm to permit the passage of vehicles without the use of aids other than pioneer tool equipment and chains.

a. Stress the following in preliminary remarks: That before crossing the boggy ground the reconnaissance should be more thorough than for any other type of cross-country driving. That reconnaissance should reveal, so far as possible, the following:

(1) The depth of the soft surface soil and all irregularities in the firm subsoil underneath (if any).

(2) The need for assistance (of all sorts) and the extent to which such assistance will keep the vehicle moving.

(3) Whether or not the vehicle can get through without becoming mired.

b. Briefly discuss the following points which will prove of assistance in crossing boggy ground:

(1) If reconnaissance indicates that chains or other aids to traction are necessary, these should be fitted before driving onto the soft ground.

(2) If more than one vehicle is to make the crossing, the vehicles should not drive in the same tracks but each vehicle should select its own route.

(3) The driver should shift into the lowest gear required to make the crossing before driving onto the soft ground.

(4) It is very important to keep the vehicle in motion and to avoid stopping, starting, or shifting gears, as the traction is so slight that miring will likely result.

(5) If a driving wheel loses traction and starts to spin, the clutch should be disengaged at once to prevent the spinning wheel from digging into the mire.

(6) Under such circumstances the driver should shift into reverse gear and try to back the vehicle up slowly and carefully.

(7) If the driving wheels continue to spin when the driver attempts to drive the vehicle either forward or backward, the clutch must be disengaged at once.

(8) Under these circumstances, the driver should not continue to try to drive the vehicle out of the difficulty, for to do so will only dig it in deeper.

(9) If a vehicle has become mired, the next thing to do is either to use pioneer tools to clear muck away from behind wheels so that the vehicle may be backed out and a new route selected, or to select and apply the means of increasing traction that seems most likely to succeed, which may be any or all of the following:

(*a*) Reinforce the soft surface by placing brushwood, timbers, stones, cloth or other material under the driving wheels. Emphasize that if this procedure is followed, the materials used should be strong enough and firmly enough in place so that they will not be destroyed or hurled from beneath the wheels as the engine power is applied.

(*b*) Use winch, block and tackle, or manual assistance to free vehicle.

(10) Point out that when driving in soil rich in clay, if clay adheres to the wheels, straight-edge shovels or boards should be held over the wheels by soldiers so that they will cut away the accumulating muck as the wheels revolve and thereby help to prevent miring. (Demonstrate safe procedure.) Emphasize that if this is done, persons holding the emergency scrapers must be warned to stand in such a position that, if the scrapers are wrenched out of their hands by the spinning wheels, there will be no danger of their being struck and injured.

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c. Ask the question: "Do you think that vehicles can get through this place without other assistance than chains?" (The answer should be "Yes." If it is not "Yes," explain why it should be "Yes.") Have an assistant instructor drive across the boggy place using chains if required, while student drivers observe. Have student drivers, one at a time, drive their vehicles across the bog. Before they start, tell them what gear they should use to make the crossing. Have them put on chains if necessary, before reaching boggy ground, and remove chains immediately after crossing is made. If any vehicle becomes stuck, have student drivers manhandle the vehicle free or have assistant instructor drive it out.

d. Repeat practice until students are proficient in driving across moderately boggy ground, keeping vehicles steadily in motion, and rocking them out of mired places, or using pioneer tool equipment if stopped.

260. Crossing bridges.—Assemble student drivers, vehicles, and assistant instructors before the approach to a bridge, and explain that in crossing bridges usually one or more of the following difficulties are encountered:

a. Bridges may be too weak to support the vehicles or they may be damaged, with the result that a certain amount of pioneer work must be done to make them safe.

b. Bridges may be slippery with sleet, ice, or moisture, with the result that extra caution is required.

c. Bridges may be very narrow, with the result that they must be crossed with extreme skill or with the aid of improvised rails to prevent wheels from going over the sides.

Discuss any precautions necessary for crossing the bridge before which they have assembled, and have each student drive over it.

261. Fording streams.—*a.* Assemble student drivers, vehicles and assistant instructors on the bank of an easily fordable stream which presents the following characteristics: It is not deep enough at any point so that the electrical equipment on vehicles will be submerged. Stream bottom is firm enough to permit vehicles to cross, and level enough so that pioneer work will not be necessary.

b. Stress the following in preliminary remarks: That before crossing shallow streams, a reconnaissance must be made. Explain that the reconnaissance must reveal the following:

(1) Whether or not the stream is shallow enough throughout the crossing so that no part of the vehicle's electrical equipment will be submerged.

(2) Whether or not the stream bottom is passable; that is, firm enough to permit the vehicles to cross and level enough so that pioneer work (filling in with stones, etc.) will permit the vehicles to cross.

(3) That the terrain on the opposite side of the stream is such that the vehicle can proceed after crossing the stream.

c. Stress that if the driver cannot see the stream bottom for the entire distance across, or cannot see the conditions on the opposite bank of the stream, or does not know such conditions in advance, he must take no chances, but wade across and find out for himself.

d. Emphasize that if the stream is of such depth that the vehicle's fan may touch the water at any point, the generator must be loosened and pushed up against the block before crossing, thus loosening the fan belt. If this isn't done, the fan will throw water on the electrical system.

e. Explain that in the present practice, student drivers will follow the same track in driving across the practice stream. Emphasize, however, that under circumstances where the bottom is sandy or muddy, and several vehicles must cross in succession, drivers should avoid following in the path of any vehicle which has previously crossed the stream. The successive impact of several vehicles would make the forded place deeper, and eventually impossible for crossing.

f. Stress that the crossing must be made at the slowest possible speed and in the lowest gear. This will prevent splashing water on the electrical units, as well as preventing strain on the vehicle.

g. Have an assistant instructor drive across the stream. At the same time explain in what ways he is following the procedure just described. Ask student drivers for comments and questions. Clarify any points not clear.

h. Now have student drivers, one at a time, practice driving across the stream. If it is necessary for student drivers to disconnect fan belts of their vehicles, have them do so before starting. Tell them what gear they should use. If the generators have been loosened, have student drivers tighten them to proper fan-belt tension immediately after making the crossing. Have student drivers practice crossing the stream back and forth as many times as necessary for them to master the operation. Next, have them practice under varying conditions by fording the same stream or different streams at various points, as time permits.

262. Ascending steep grades.—*a.* Select a grade which may be climbed without much difficulty. It is preferable that there be sufficient space at the top of the slope for all vehicles to park. There

should also be a moderate descent on the opposite side so that vehicles can continue down the hill and circle around to the starting point. However, if these conditions do not exist, you must vary your method of teaching in accordance with the limitations present. Under very bad conditions, it may be necessary to have students drive up a slope, one at a time, and then have assistant instructors turn vehicles around and drive them down before practice can be repeated.

b. Assemble student drivers, vehicles, and assistant instructors at foot of slope. Explain that the following are the chief reasons why vehicles become stalled or stop on steep grades:

(1) Because the engine is not providing enough power to the wheels, usually as a result of failure of the driver to use the proper gear.

(2) Because the wheels cannot get enough traction on the slope, either because the slope is extremely steep or because it is slippery. Under these conditions the wheels will spin without advancing the vehicle up the slope.

(3) Because there is not enough weight on the front wheels with the result that the vehicle cannot be steered but tends to turn sideways on the slope.

(4) Because the vehicle and its load are not heavy enough, in which case the load must be increased.

c. Ask if the slope is too slippery or too steep to be climbed. It will not be too steep; however, you should now point out that, when climbing very steep grades, the use of various mechanical aids will be necessary. Remind the students again that later in the course they will have instruction in the operation and use of the winch, block and tackle, etc.

d. Point out that before climbing a steep grade, the correct gear should be selected and the shift made to the gear. Also determine if front-axle drive should be used and if transfer-case gearshift lever should be placed in low range. Ask what gear will provide enough power to climb the slope. Explain why incorrect answers are wrong and why the correct answer is right. Stress that driver should depend on engine power and not momentum to carry him up the slope. This will do away with driver having to change gears while going up slope.

e. Ask if it will be necessary to use chains. If so, have student drivers put on chains.

f. Call special attention to the fact that many slopes level off at the top so sharply that drivers must guard against damaging the bottom of the radiator, front axle, etc.

g. Emphasize that if two or more vehicles are climbing a slope in column, they should always keep far enough apart to avoid accidents should any vehicle get out of control and slide back down the slope.

h. After hill has been checked for suitability, have assistant instructor drive up slope, explaining the methods he is using to climb slope correctly and the reasons he is using them. Ask for and clarify all questions. Then, have student drivers drive up slope, one at a time, and park at top (assuming that there is sufficient room for this to be done).

i. Do not have succeeding vehicles start up the slope until the drivers of the vehicles ahead have cleared the crest, parked, and signaled the others to come ahead. With all vehicles parked at top of the slope, have vehicles return to the starting point. They should be driven down the opposite side of the slope and returned by the students themselves, or driven by the assistant instructor down the slope just ascended.

j. Have students repeat driving up slope until proficient. While practice is going on, point out and correct all errors.

263. Descending steep slopes.—*a.* Assemble student drivers, vehicles and assistant instructors before a steep descent which may be negotiated with safety by the student drivers. Point out that, when descending any steep slope, drivers should always shift to the proper gear and range before starting the descent. Indicate that the gear used in descending a given slope should be the same gear as would be used in ascending a slope of the same grade. Emphasize that by keeping the vehicle in gear throughout the descent, the braking effect of the engine is in effect, and that less use of the foot brake is required. Stress that these general rules should be observed when descending all steep grades.

b. Ask and draw out the correct answers to the following or similar questions:

(1) What is the best gear for descending this grade?

(2) Why is this gear better than other gears?

(3) What range should be used?

(4) Why should gears not be changed while descending the slope? (Drivers are likely to lose control of vehicle or strip gears.)

(5) Why should the clutch be fully engaged while descending steep slopes?

(6) How does the engine hold the vehicle back when descending a slope with the clutch engaged, while it pulls the vehicle ahead in level ground driving?

(7) What damage to the brakes results from excessive use?

(8) If the vehicle starts to pick up speed, what is the best way to use the brakes to avoid damaging them? (Apply them intermittently.)

c. Have an assistant instructor drive down the slope while student drivers observe. Ask for comments.

d. Instruct student drivers that in descending grades there should always be sufficient distance between vehicles so that if any vehicle gets out of control it will not strike the vehicle ahead.

e. Have student drivers, in turn, drive down the slope. Have them repeat this practice, while you or assistant instructors observe all errors, until they have mastered the maneuver.

264. Special techniques in ascending and descending difficult slopes.—Have student drivers practice both ascending and descending, using increasingly difficult slopes which can be negotiated without the use of mechanical aids. However, before beginning this field work, instruct students in the following:

a. Ascending.—(1) If a vehicle stalls for any reason, the driver should not disengage clutch until he has made certain that the brakes can hold the vehicle without the assistance of the braking effect of the engine.

(2) If the brakes will not hold the vehicle, shift into reverse gear and slowly back down the slope, slipping and reengaging the clutch to control the rate of descent. (This procedure is necessary only in very unusual circumstances.)

(3) Poor traction on a steep slope may frequently be increased by adding to the weight of the load (rocks, logs, men, or whatever else is handy).

(4) If steering is difficult, adding more weight over the front wheels or shifting the load so that more weight is over the front wheels will improve steering.

(5) Sometimes additional traction may be gained by steering so that the driving wheels are pressed against the sides of ditches or ruts.

(6) If the vehicle will not climb the slope because the load is too heavy, the load must be lightened, the vehicle driven up the slope, and then the load carried to the top of the slope and replaced.

b. Descending.—Before student practice in descending difficult slopes, emphasize:

(1) Driver should never coast down a hill with the clutch disengaged.

(2) If a gear has been selected that is too high and the vehicle starts to get out of control, the brakes should be used intermittently and the driver should shift to a lower gear.

(3) When a vehicle out of control cannot be stopped by the brakes and engine, the driver should, as a last resort, ditch the vehicle against a bank, at a sharp angle if possible.

(4) The driver should never attempt to "ride it out" in a vehicle that is out of control, for by doing so he is likely to wreck the vehicle and injure himself.

265. Driving in sandy and loose soil.—*a.* Assemble drivers, vehicles, and assistant instructors before a stretch of terrain where the soil is sandy or loose. Point out that—

(1) It is usually necessary to make a careful reconnaissance to determine the best route.

(2) After the route has been selected, the best chance of getting through is by keeping the vehicle moving.

(3) The driver should select and use a gear which will provide some speed with sufficient power to pull it through.

(4) Generally, if more than one vehicle is in the column, vehicle should follow in the same tracks.

(5) If it looks as though the going will be very bad, better traction can be obtained by letting some of the air out of the tires. (Emphasize that if this is done, the tire should be pumped up to correct pressure immediately after the difficult stretch has been crossed, to prevent tire wear.)

b. Now have student drivers reconnoiter the terrain and select their own route. Point out why they have chosen the best route or why their route is not the best, and the route to be followed.

c. Have assistant instructor drive over the route. At the same time explain what driving skills he is using to get through safely and without damaging the vehicle. Ask for questions and clarify answers.

d. Have student drivers prepare their vehicles in whatever way may be necessary (letting out air in tires, etc.).

e. Have students drive over the route one by one, point out errors and, so far as time and the terrain permit, select new points and repeat the practice.

266. Driving in woods or underbrush.—*a.* Stress the following points:

(1) Drivers should make sure that the soil is capable of supporting a vehicle.

(2) Extreme caution should be used to prevent getting bogged down, particularly when driving in low-lying wooded country.

(3) Do not attempt to ride down underbrush which is large enough to cause damage to the vehicle.

(4) Drive around underbrush or trees, or if there is no way to drive around, chop the obstacle down.

(5) If the ground is firm and there is more than one vehicle in the column, drivers will save time and work by following in the same tracks.

b. Select a wooded area and have student drivers practice driving as much as time permits.

267. Driving under extremes of weather and climate.—Obviously, if you are stationed in Boston, you cannot give student drivers practical experience in driving under desert conditions, or if you are located in Hawaii, you cannot give them practical experience in below zero operation. Therefore, your field instruction must be limited to those conditions which actually are present. Those conditions which are not present must be discussed so that drivers will have a knowledge of what to do under extremes of temperature or humidity. The procedure in paragraphs 268 and 269 is limited to classroom instruction. The instructor should supplement it by actual field work whenever the conditions are such that he can do so.

268. Driving in cold weather.—*a. Antifreeze.*—Ask at what temperature water freezes. Ask leading questions until you have established the fact that water expands when it freezes. Ask what other substances expand when freezing. (None.) Ask what effect water, if inclosed so that it completely fills a rigid container, will have on the container if it freezes. Point out and explain how freezing makes a motor vehicle useless until the water is thawed out, and how freezing frequently causes serious damage to the engine. Stress the following points:

(1) Sufficient antifreeze must be in the cooling system at all times when the temperature is below freezing or likely to fall below freezing.

(2) Drivers must be on the alert against possible drops in temperature.

(3) Temperature frequently falls 20° to 30° in a few hours, and at high altitudes it may fall 50° or more in a short time.

(4) Drivers must keep enough antifreeze in the cooling system of vehicles to protect against the lowest possible temperature.

(5) The level of the antifreeze and water mixture in the radiator should be sufficiently below the top of the overflow pipe to prevent loss after the mixture becomes hot and expands.

(6) When driving in extreme cold, the lower half of the radiator may be shielded with heavy paper, cloth, or other material that will

prevent the passage of air through the radiator core. This reduces the radiation of heat, thus preventing rapid cooling of the engine.

b. Starting engine in cold weather.—Point out the following useful hints for starting the engine in very cold weather:

(1) Precautionary measures to make starting easier should be taken at the previous halt and if necessary certain measures should be taken during the time the vehicle is halted and the engine is stopped.

(2) If it is extremely cold at the time the vehicle is halted, and the vehicle is to remain standing for a considerable time, such as all night, it may be advisable to drain out all the oil from the crankcase. This oil should be kept in a container near the campfire or in some other warm place to prevent congealing. However, the oil should not be replaced in the crankcase until ready to start, then the engine should be started immediately afterward. (This method is not necessary except in extremely cold weather.)

(3) If the oil is left in the crankcase in extremely cold weather, drivers can guard against hard starting by starting and running the engine for a few minutes at intervals of an hour or so during the halt.

(4) The engine must never be run at more than a very moderate speed when starting in cold weather. The driver must allow plenty of time for the oil to warm up to the point where it will circulate freely before increasing the engine speed. The vehicle should not be moved until the engine is thoroughly warmed.

c. General operation and safety hints for cold weather.—Point out the following:

(1) When halting on a wet, slushy, snowy, or icy surface the driver should place brush, weeds, boards, or other material in proper position and drive the wheels upon such material. This will help in preventing the vehicle from freezing to the ground.

(2) When halting, precautions must be taken against freezing of brakes. Drivers, when about to halt, should apply brakes severely several times to help dry the brake linings. After parking, drivers should release the parking brake and put the transmission in low or reverse gear to prevent the vehicle from rolling, since the parking brake may freeze if left on.

(3) Under no circumstances should the driver attempt to free frozen brakes by trying to force the vehicle to drive forward or backward. In such circumstances, he should consult his superior or summon or wait for aid.

(4) Defrosters and other aids to cold-weather visibility should be kept in good working order.

(5) If, in spite of all efforts to keep the windshield clear, it still freezes over so that visibility becomes so bad as to endanger driving, the driver should open the windshield.

(6) Drivers must remember that chains, while they aid traction in driving ahead or backward, are of little effect in preventing side skids on ice, in fact they frequently increase side skids. Do not increase speed or in any other way drive recklessly while depending on chains to prevent accidents. Chains should be used only as an aid to traction. They should be used on roads covered with ice and sleet only when traction is impossible without them.

(7) To prevent skidding, drivers should—

(*a*) Drive on high crowned roads with the wheels straddling the crown (if this does not interfere with other traffic).

(*b*) Enter and drive around curves slowly.

(*c*) If necessary, drive in ruts against side shoulders or snow piled alongside the road, or against other barriers which may be utilized to prevent vehicles from slipping to either side.

(*d*) Descend grades and hills slowly, putting the brakes on and off lightly and frequently to keep speed down.

(*e*) When conditions are very bad, lower the air pressure in the tires and drive very slowly. (Air pressure should be restored to normal as soon as conditions improve, as driving with underinflated tires damages sidewalls and rapidly wears out tires.)

(*f*) Use chains when driving in deep snow, exactly as when driving in deep mud or sand.

(*g*) Use chains if tires are smooth.

(8) If a vehicle gets stuck in snow, do not spin wheels and expect to get out since this will only dig the vehicle in deeper. Try rocking the vehicle out by using forward and reverse gears alternately, without spinning the wheels, until the track is lengthened and sloped at front and rear. If this is done, the vehicle should be able to climb out. Front wheels should be kept straight while rocking. If rocking fails, use pioneer tool equipment.

(9) If both rocking and pioneer tool work fail, spreading sand, ashes, or other material under the wheels may increase traction enough so that the vehicle can drive out.

269. Driving in extreme heat.—Explain that the chief dangers in hot weather operation are engine overheating, damage to tires, and the destructive effect of dust and sand on the vehicle.

a. Engine overheating.—Point out that to guard against the engine overheating, the driver must—

(1) Check on operation of fan belt frequently, making sure that fan is operating properly with the belt at proper tension—not too loose and not too tight.

(2) Keep radiator free of accumulated dirt, leaves, etc., that interfere with the free passage of air.

(3) Check water level in radiator frequently and add water to proper level without delay when necessary.

b. Tires.—To conserve tires in hot weather, check air pressure frequently. (At the end of a run, tires may be overinflated. Do not check until tires have been allowed to cool off.)

c. Sand and dust.—Point out the following aids to minimizing the destructive effects of sand and dust:

(1) The wire mesh in the base of the carburetor air cleaner should be kept clean. The oil in the air cleaner should be kept at proper level. This should be done every day.

(2) Remove, wash, soak in oil, and replace the breather pipe cap air cleaner every day.

(3) Check the crankcase oil frequently to see if it contains grit. Do this by rubbing some of the oil between the tips of your finger and thumb. If the oil seems at all gritty, report the condition to your superior immediately.

(4) Change the oil and, at the first opportunity, have the filter attended to.

(5) If a sandy or dusty wind is blowing, when pouring oil into the crankcase, protect the oil by rigging an improvised screen with a tarpaulin, blanket, etc.

(6) Guard against dust, sand, and dirt getting into the oil filler can.

I—OPERATION OF WINCH

270. General.—*a. Objective.*—To develop in student drivers the ability to operate the winch and to utilize the winch in moving the vehicle equipped with the winch, or other vehicles, or loads.

b. Place.—In field.

c. Equipment.—Sufficient number of vehicles equipped with winches to enable all drivers to get necessary amount of practice in available time.

d. Personnel.—One assistant instructor, if possible, for each student driver.

e. References.

TM 10–1147, Maintenance Manual, GMC 2½-ton 6 x 6.
Motor Transport Technical Service Bulletin Z–10.
Motor Transport School Text No. 16, Military Motor Transportation.
TM 10–460, Driver's Manual.
Driver Training Film 11–555.

f. Note to instructor.—Assemble student drivers, one assistant instructor, and two vehicles (one equipped with front-mounted winch, ropes and chains, block and tackle, anchor stakes, traction devices, and pioneer tool equipment) on a level open space adjacent to difficult terrain.

271. Preliminary remarks.—Point out that student drivers have reached a stage in their training at which they have become proficient in the operation of their vehicles on both easy and somewhat difficult terrain; and that they have learned the use of pioneer tools, ropes and chains, traction devices, other vehicles, and manual assistance in rescuing stuck vehicles. State that they are now to learn the use of the winch. It is present on some vehicles at all times, and if properly used, it is capable of applying greater effort than all the other aids combined.

272. Definition of winch.—Ask student drivers to define a winch. (The winch on a military motor vehicle is a windlass that operates on power furnished by the vehicle's engine and is geared in such a way that it can pull on a steel cable by winding it around a drum supported between the side rails of the vehicle's frame.)

273. Source of power.—Briefly explain how the winch receives its power (have assistant instructor point out each unit in turn):

a. Power take-off unit.—Power for operation of the winch is transmitted from the main transmission through a power take-off unit bolted to the transmission. In the case of the winch, the power take-off unit fulfills a function similar to that of the transmission gears in the case of the power train. Shifting is controlled by a power take-off unit gear shift lever located in the cab. (See fig. 36.)

b. Winch gears.—The power take-off unit has two gear ratios for lifting or pulling (winding), and one gear ratio for lowering (unwinding). There are two neutral positions, one between low and reverse, and the other between reverse and high. (See fig. 36.) From the power take-off unit, power is transmitted to the front of the vehicle by a propeller shaft.

c. Winch worm housing.—At the front end of the propeller shaft, connection is made with a gearing arrangement inclosed within a gear case called the winch worm housing. (See fig. 37.) This gearing arrangement transmits power to the winch axle or drum shaft on which the drum is mounted.

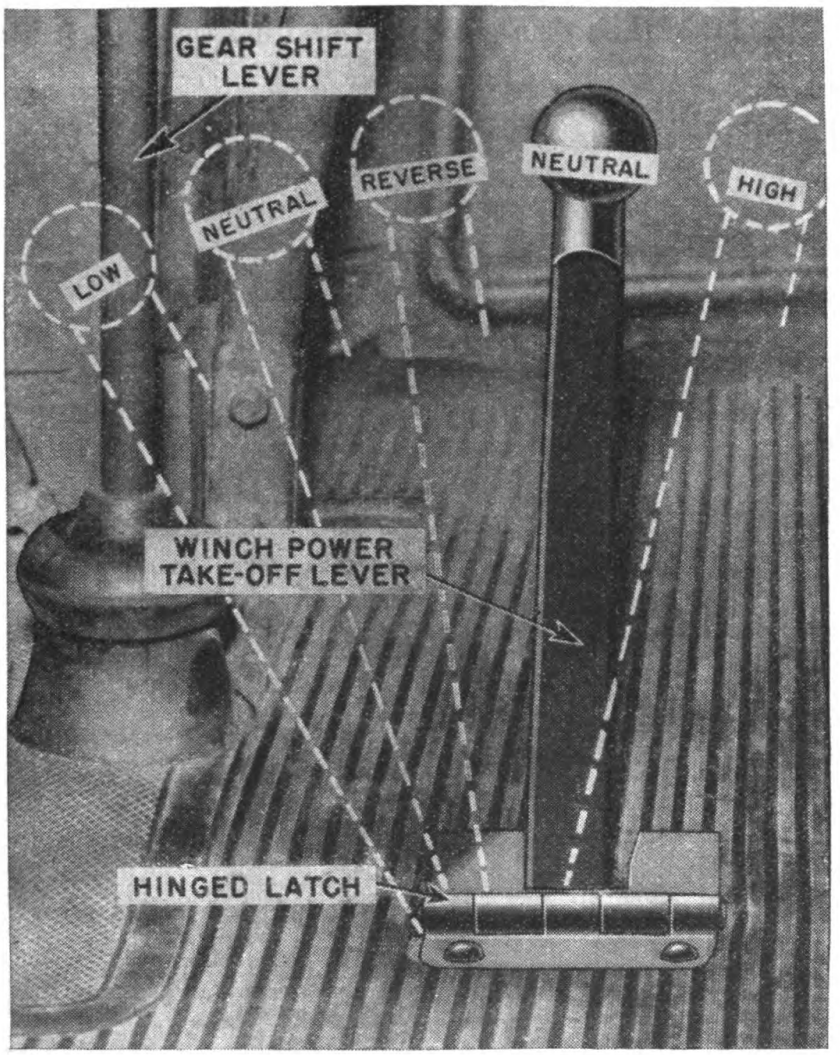

FIGURE 36.—Winch power take-off lever in cab.

274. Shear pin.—Point out the shear pin (fig. 37) provided between the propeller shaft and the gear housing. Emphasize the following:

a. The shear pin is designed so that it will break before excessive strain can be put upon the winch.

b. Drivers should never replace a broken shear pin with a steel rivet or other piece of metal. If this is done and the driver continues

to operate the winch, instead of what should be a soft shear pin breaking, other parts may break and personnel may be seriously injured.

c. Broken shear pins should be replaced only with the manufacturer's regular soft-metal shear pins. The driver must keep at least two spare shear pins in his vehicle at all times.

275. Automatic safety brake.—Point out the automatic safety brake at the end of the worm-gear drive and indicate that it keeps the

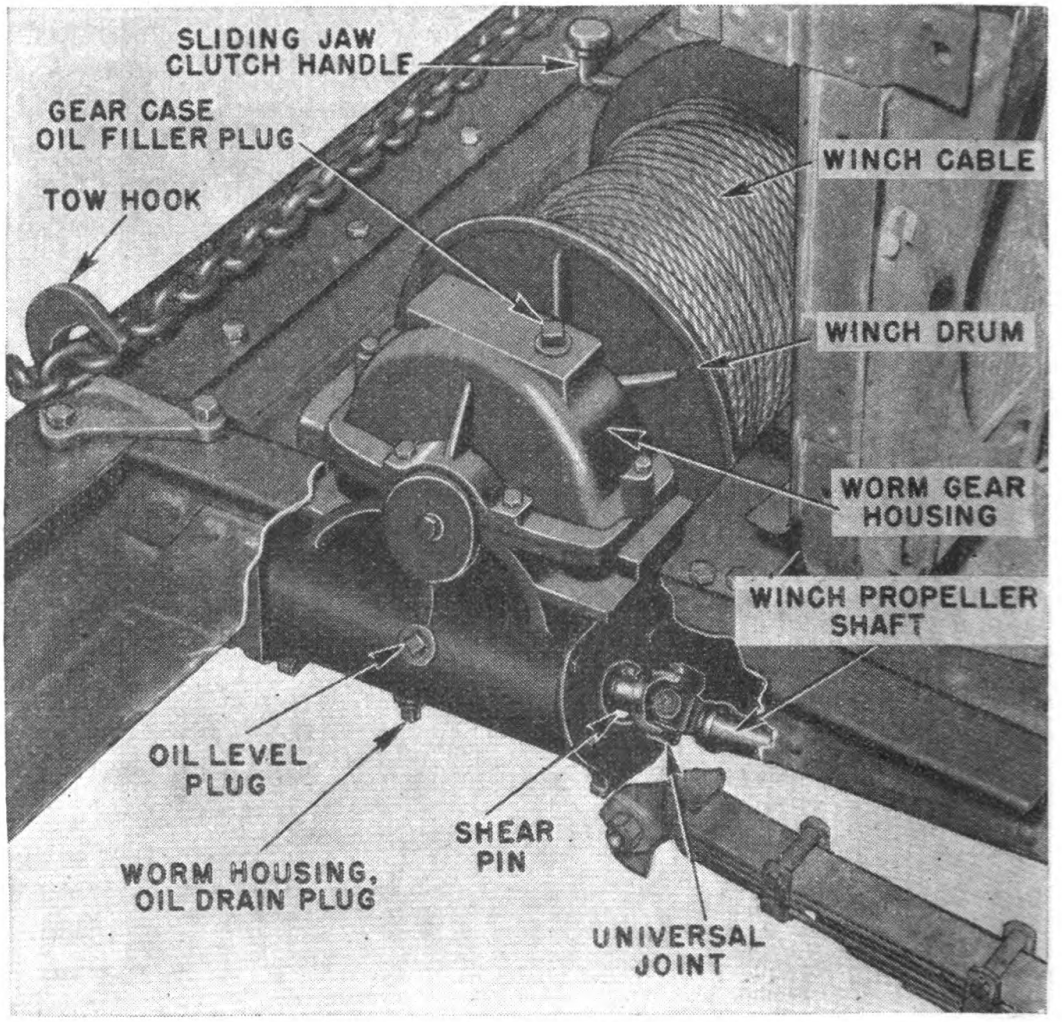

FIGURE 37.—Details of a front-mounted winch.

cable from unreeling and holds the load in place in case the shear pin breaks or the winch is declutched from the transmission. Emphasize that the adjusting nut beneath the winch drum and the right of it is used to regulate the tension on the safety brake. The safety brake should be tight enough to hold the load being winched when the clutch is pushed down. When the winch is driven, the safety brake warms up but this is not an indication that anything is wrong with the brake.

Regardless of whether or not the brake gets warm, it must be tight enough so that it will hold the load when the clutch is pushed down, but not so tight that it gets too hot to touch.

276. Sliding jaw clutch.—Point out the hand-operated sliding jaw clutch (fig. 37) located at the right end of the winch drum. Indicate that the sliding jaw clutch permits the drum shaft and drum to be engaged or disengaged at will. Also, that the sliding jaw clutch must be kept engaged at all times, except when pulling the cable off the drum by hand. If the sliding jaw clutch is not kept engaged, the cable and chain may unwind and drag on the ground, in which case serious damage might result.

277. Winch shift-lever.—*a.* Have assistant instructor get in cab and shift winch power take-off shift lever through all its positions while you explain each position as follows:

(1) Reverse speed position in which the cable is unreeled from the drum or spool.

(2) The two neutral positions into which shifting is done when changing from one gear ratio to another and from forward ratios to reverse.

(3) Low-speed position, in which the cable is wound on the drum at slow speed and with a maximum of effort.

(4) High-speed position, in which the cable is wound on the drum at a greater speed and with less effort.

b. Have assistant instructor repeat shifting through these various positions until the student drivers know their location.

278. Winch and driving wheels operating simultaneously.—Explain that the winch may be used either to assist the vehicle, with the vehicle's wheels driving, or independently of the driving wheels. Emphasize that when the vehicle is in motion, the winch may be operated only if the vehicle is being driven forward in the lowest gears and that the winch also should be in low forward gear. As you stress this point, have assistant instructor place the transmission and transfer-case shift levers in low range and the power take-off lever in low speed.

279. Winch operating with driving wheels stationary.—To demonstrate the operation of the winch with the driving wheels disengaged, have assistant instructor shift transmission and transfer case into neutral positions. Have assistant instructor depress clutch pedal and shift power take-off control lever into low or high-speed positions. Explain that when the load is heavy, low speed gear must always be used; that when the load is light, high speed may be used. Have assistant instructor slowly release clutch pedal, at the same time

stepping on accelerator (ignition off). Explain that in actual operation as the clutch pedal is let up and the engine is accelerated, the cable will begin to wind up and will wind at a speed proportionate to the speed at which the engine is run. Explain that this speed will be greater if the power take-off shift lever is in the high-speed position than if it is in the low-speed position.

280. Speed precaution.—Stress that when using the winch the driver should never operate the engine at a speed greater than 1,000 revolutions per minute. Ask for questions and clarify all points not understood.

281. Stopping the winch.—Have the assistant instructor demonstrate, while you explain, the following procedure in stopping the winch: Depress clutch pedal and shift power take-off control lever into the neutral position located between low and reverse, or between high and reverse, depending on whether the winch is being operated in low or high speed.

282. Operating winch in reverse.—Have assistant instructor demonstrate shifting power take-off lever into reverse and regulating the speed of the winch by the accelerator as it is used to unwind cable (for lowering loads, etc.).

283. Lowering loads.—Emphasize that drivers should never try to lower a load by disengaging the sliding jaw clutch and letting the weight of the load unwind the cable. Stress that reverse gear should always be used when lowering a load.

284. Stopping from reverse.—Point out that the procedure for stopping the winch when it is operating in reverse gear, is the same as when stopping from either of the forward speeds; that is, to depress the clutch pedal and to shift the power take-off control lever into neutral position.

285. Locking winch shift lever.—Have assistant instructor lock winch shift lever with hasp lock on floor of cab. Emphasize that this lever must be locked at all times when winch is not in operation to prevent the driver accidentally kicking or the vehicle jarring the winch into gear when the vehicle is in motion.

286. Cable, drum, chain, and hook.—Point out the arrangement of the cable on the drum. Indicate that the cable is equipped with a section of chain and hook for use in fastening onto objects. Call attention to the way the winch chain is attached to the tow hooks when the winch is not in use. Stress that this connection should always be tight when the winch is not in use, as otherwise the chain might become unhooked and fall off, possibly causing serious damage. Explain that after using the winch, the cable should be wound up, the

chain attached to the tow hooks, and the winch operated very slowly and carefully until the cable becomes drawn tight. Emphasize that this must always be done after use of the winch.

287. Winding of cable.—Have a student driver unhook the chain and pull out cable, walking straight ahead of the vehicle until the cable is entirely unwound. Explain that when the winch is pulling, it is very important that the cable wind back on the drum tightly and evenly. Emphasize that the winching vehicle should be in line with the direction of the pull. If this is not possible, a block and tackle must be rigged at some point in the pull so that the cable will wind straight onto the drum.

288. Rules for proper use of winch and protection of personnel.—Emphasize the following rules for proper use of winch and protection of personnel:

a. The winch cable should never be rigged around a sharp angle or against a sharp object.

b. In winding the cable or taking up slack, the driver should be careful to straighten out all kinks and twists in the cable.

c. The driver should not permit vehicles equipped with metal tires or traction devices to run over the winch cable.

d. When the winch cable is attached to the anchorage or object to be hauled, the hook should not be fastened upon the cable, because if this is done, it will cut the individual strands of the cable when tension is applied. Instead, it should be fastened into the eye of the chain or around the chain.

e. Remember that when attaching the winch rope to a vehicle, the driver should pass the cable through one tow hook and then across the front of the vehicle to the other tow hook.

f. The winch should always be operated slowly and carefully.

g. Load strains should be applied gradually. Drivers should avoid sudden jerks which may damage the rope, winch, vehicle, or load.

h. The winch cable should be kept taut when hauling or lowering a load.

289. Operation of winch (demonstration).—*a.* Have a student driver park a second vehicle in such a position that the extended cable from the first demonstration vehicle may be secured to the pintle at the rear of the second vehicle.

b. Have the student driver put on the hand brake of the second vehicle.

c. Then, have another student driver secure the chain and cable to the second vehicle.

d. Assistant instructor should now start the engine of vehicle number one and slowly wind up the cable on the drum, pulling his vehicle ahead.

e. Have assistant instructor stop vehicle No. 1 every few feet while you point out that the cable must wind up so that the coils are tight against each other. If this is done, when the next layer is wound on, it will not be able to jam down between the coils of the row underneath. Demonstrate how coils can be kept tight against each other by tapping the cable with a block of wood or a hammer.

f. Point out that the procedure cited in *e* above is often necessary when winding the first layer of cable and that after the first layer of cable is wound, the beginning and end of each layer should be watched. Indicate that at all times while the cable is being wound, the truck should be kept lined up with the object which is furnishing tension to the cable. Point out that some trucks are equipped with a fixture which maintains a slight tension on the cable and guides it into the drum as it is wound when no load is being pulled. (If the truck you are using for instructions is equipped with this fixture, point it out and explain its operation.)

g. After the cable has been completely wound, and the assistant instructor's vehicle has been brought close behind vehicle number two by the winding of the winch, have a student driver demonstrate proper procedure of unfastening hook and chain and securing them to the front of vehicle No. 1. Now have assistant instructor wind up cable until the chain is taut, and then have a student driver engage the sliding jaw clutch. Point out that winding the winch cable when no load is being hauled can be accomplished most easily if one or two persons feed the cable back to the drum while the driver operates the winch. (Gloves or some protection for the hands should be used. Oily rags are good.) Add that if no help is available, the driver should fasten the cable to an anchorage, set his vehicle brakes lightly and gradually wind up the cable by operating the winch, hauling the vehicle ahead a few feet at a time, stopping and getting out at intervals to check, and if necessary, adjusting the manner in which the cable is winding on the drum. Ask for questions and clarify all points not clear.

290. Operation of winch (student practice).—*a.* Assign student drivers and vehicles to assistant instructors and have student drivers perform the following operations:

(1) Operate the winch in reverse gear until the chain is loose on the tow hooks.

(2) Unfasten winch cable.

(3) Unreel winch cable. Fasten winch cable by chain and hook to a suitable anchorage in the line of the vehicle's travel.

(4) Pull vehicle forward by use of the winch, with the driving wheels disengaged until the winch cable is fully wound on drum.

(5) Unfasten chain and secure to the tow bars.

(6) Operate the winch in low gear until the chain is taut.

(7) Continue this practice, while assistant instructors supervise, until student drivers are proficient.

b. Reemphasize that when the driving wheels are used to assist the vehicle, the winch can be operated only in low gear and with the transfer-case shift lever in low range. Point out that the driving wheels should never be used to assist the winch except in extreme emergency, as the jerking on the cable caused by the wheels slipping in difficult terrain may result in serious damage.

c. Have student drivers, under the supervision of assistant instructors, practice shifting into low gear both with transfer-case shift lever and power take-off lever.

d. Have student drivers practice hauling vehicles forward by use of the winch when the driving wheels are operating.

e. Repeat practice using the winch for straight pulls only until student drivers are proficient in operating the winch in both forward gears, in reverse gear, and with and without the driving wheels in operation.

291. Winch maintenance rules.—At the conclusion of this practice, point out that—

a. The driver must keep the winch, cable, and chain in good condition in accordance with the preventive maintenance schedules, and should report all defects to his superior. The driver should keep the winch cable clean and oiled at all times. (Used crankcase oil is satisfactory for cleaning the winch cable).

b. When cleaning the winch cable, the driver should wear heavy gloves to prevent injury to his bare hands by broken strands. (Broken strands should be reported immediately).

c. After using the winch, the driver should make sure that the cable is properly wound, that the chain is properly secured to the two hooks, that the chain is taut, and that the sliding jaw clutch is engaged.

d. The driver should keep at least two spare shear pins on his vehicle at all times.

J—USE OF WINCH IN DIFFICULT SITUATION

292. General.—*a. Objective.*—To develop in student drivers the ability to rescue stuck vehicles by the use of the winch under various conditions.

b. Place.—On difficult driving range.

c. Equipment.—Sufficient number of vehicles equipped with winches to enable all drivers to get necessary amount of practice in available time; ropes and chains; block and tackle; pioneer tool equipment; traction devices; logs for burying a deadman and for erecting an A frame; and anchor stakes.

d. Personnel.—One assistant instructor to each vehicle.

e. References.

TM 10-1147. Maintenance Manual, GMC 2½-ton 6 x 6.
Motor Transport School, Text No. 16, Military Motor Transportation.
TM 10-460, Driver's Manual.
Driver Training Film 11-555.

293. Anchorage.—Assemble student drivers, assistant instructors and vehicles on difficult driving range and point out that the first essential to operation of the winch is a firm anchorage of some sort. Point out that the winch cable is 300 feet long, and that before attempting any hauling job with the winch, the driver must make sure that he has a firm anchorage available within the radius. State that this anchorage may either be the vehicle itself, in case it is pulling another vehicle; or another vehicle, in case the winch is located on the stuck vehicle. Other anchorages may be trees, large boulders, stakes driven into the ground, or any other natural or improvised support strong enough to resist the pull of the winch.

294. Safety precautions.—Emphasize that the driver must be sure that the winch mechanism, the cable, and the vehicle frame are strong enough to resist the maximum tension that is likely to develop in making the pull. Emphasize that the driver should know the shear pin strength, or actual winch capacity, of the vehicle he is operating. Emphasize that he should not attempt a pull that is likely to exceed this capacity. Stress that driver should not stand close to the cable during use, for it might snap and strike him.

295. Estimating winch capacity.—Emphasize that the capacity of the winch is fixed according to tonnage of the truck to which it is attached. The winch capacity of 1½-ton trucks is 10,000 pounds or 5 tons; of 2½-ton trucks, 10,000 pounds or 5 tons; of 4-ton trucks, 15,000 pounds or 7½ tons; and of 7½-ton trucks, 25,000 pounds or 12½

tons. Point out that drivers may also be able to determine the capacity of the winch from the specifications plate mounted on the vehicle.

296. Snatch blocks.—Have an assistant instructor place snatch blocks on ground and explain their function as follows:

a. When the cable is run through a snatch block and back to a tow-hook on the vehicle, the pull will be distributed through two sections of the cable instead of one, the strain on the winch and cable will be reduced one-half, and consequently the winch capacity will be doubled.

b. If one or more snatch blocks are used in such a way that the strain is distributed over three sections of cable, the winch capacity will be tripled, etc.

297. Choice of anchorage.—Have student drivers point out anchorages of sufficient strength to resist the pull of winches of various capacities. (Tree, post, frame of building, boulder, rock, ledge, etc.)

298. Vehicle anchorage.—Point out that a firm anchorage may be provided by attaching a tow chain from the pintle on the vehicle to another vehicle. Add that if necessary, several vehicles can be connected together in this way.

299. Burying a deadman.—*a.* Instruct student drivers that if no vehicle or vehicles are available to assist in providing an anchorage, a simple and effective anchorage may be improvised by burying a deadman.

b. Point out that to bury a deadman, the driver needs only a sufficiently strong log and pioneer tool equipment; and that a deadman may be buried in almost any type of ground in which a trench can be dug.

c. Have student drivers, under the supervision of several assistant instructors, use pioneer tools and bury a deadman as follows: Find a strong timber of several feet in length and 6 to 12 inches in diameter. (A railroad tie is about the right size.) Dig a trench a little longer that the timber and about 4 feet deep in such a way that it is at right angles to the direction of pull desired. The trench should be dug so that it slants downward and inward on the side nearest the vehicle. This is done so the trench will hold the deadman down and in when the pull is exerted.

d. Add that it is necessary to dig a second trench bisecting the trench already dug and extending in the direction of the pull. This trench is for the cable to lie in so that it can reach down to the deadman without becoming fouled in the ground. The trench will give a clear area to the line. This second trench should be as deep at the point of intersection to the deadman as the trench holding the deadman. The cable trench should gradually grow shallower and shal-

lower in the direction of the pull, until the cable emerges above ground. Now have student drivers dig this second trench under the supervision of assistant instructors.

e. Have student drivers drive vehicles to point where winch cables may be unwound and chains secured around the deadman. Have student drivers fasten cables around the deadman and bury the deadman in trenches, placing cables along inclined trenches as described. Have student drivers operate winches, pulling vehicles ahead.

300. Multiple anchor stakes.—Lay out at least one set of multiple anchor stakes and explain that these may be used as an artificial anchorage in places where no natural anchorage is available, and where the ground is reasonably firm. Have student drivers practice method of installing those stakes, while you explain as follows (see fig. 38):

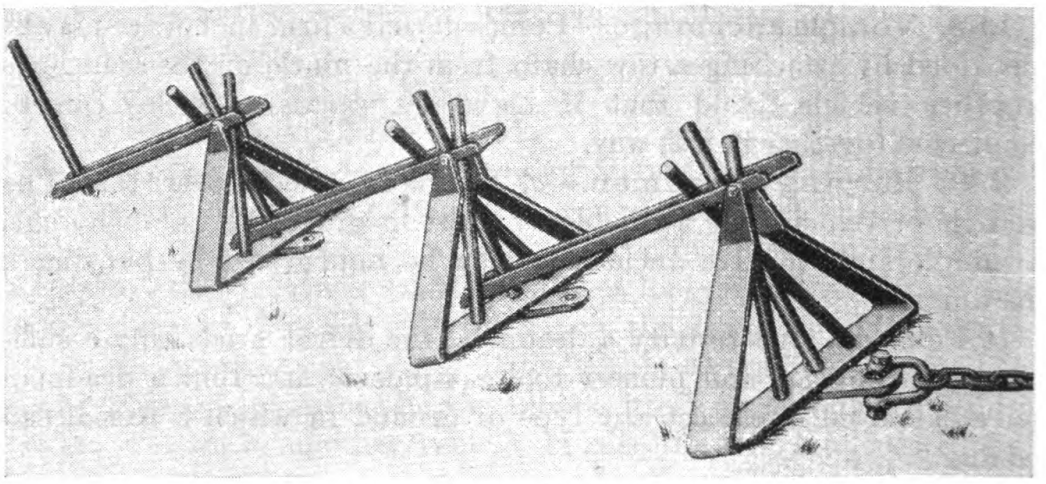

FIGURE 38.—Anchor stakes.

a. Set stakes in a straight line in the line of pull, and space them 4 or more feet apart.

b. Drive stakes as deeply as possible into solid ground and slant them at an angle of from 30° to 60° in the direction away from the pull.

c. Lash or chain stakes together as tautly as possible so that the pull will be equally distributed among all stakes. The more taut the connection between the stakes, the less possibility that the stakes will be pulled from the ground one by one.

d. Attach the winch cable chain or snatch block to the anchor stake closest to the vehicle. Explain that there may be circumstances when the use of many anchor stakes will be necessary to absorb the pull, and in such cases, the drivers of several vehicles should pool their anchor stakes, which may be set in one long line, or set in two or more parallel lines with the pull distributed between the lines by use of an improvised spreader bar.

301. A-frame.—*a.* Point out that vehicles may become so deeply mired that it will be impossible to get them out by using a straight pull. Emphasize that if a straight pull is attempted under such conditions, it is likely that the springs of the vehicle will be bent or broken, the frame damaged, or the axle pulled away from the vehicle.

b. Stress that under those circumstances a straight pull should never be attempted. An A-frame should be erected for the purpose of providing both a lifting and a forward pull.

c. Have student drivers go through the process of erecting A-frames and lifting and moving vehicles, while you describe the operation as follows:

(1) Select two sturdy logs of 7 or more inches in diameter and about 12 feet long.

(2) Chain these logs together around the top and stand them in shallow holes several feet in front of the vehicle to be lifted and hauled, and tilting toward that vehicle. (See fig. 39.)

(3) Pass the winch line from the hauling vehicle across the top of the A-frame and down to the front of the vehicle to be hauled.

(4) Put the winch in operation. (The A-frame will be drawn upright and over in the direction of the pull with the result that the mired vehicle will be lifted and hauled forward several feet.)

(5) Now move the A-frame forward a few feet in the direction of the pull and set up again as already described.

d. Explain that the process of setting up the A-frame and lifting and pulling the hauled vehicle ahead a few feet must be repeated until the hauled vehicle is on ground firm enough so that a straight pull may be applied. Point out that care must be taken to place the A-frame far enough away from the towed vehicle so that the legs of the frame will not damage the front of the vehicle when it is lifted over. Have student drivers continue to practice setting up A-frames and lifting and moving vehicles forward by successive use of the A-frame until this procedure is thoroughly learned.

Note to instructor.—At this point you have instructed student drivers in the use of snatch blocks, spreader bars, traction devices, chains, deadmen, and A-frames. The next step will be to give them actual practice in the use of the winch in rescuing stuck vehicles under various difficult conditions. Assign student drivers and vehicles to assistant instructors and have assistant instructors conduct this practice on the difficult driving range.

302. Rescuing stuck vehicles (practice).—Follow the same general procedure that was followed in teaching difficult driving without the use of the winch.

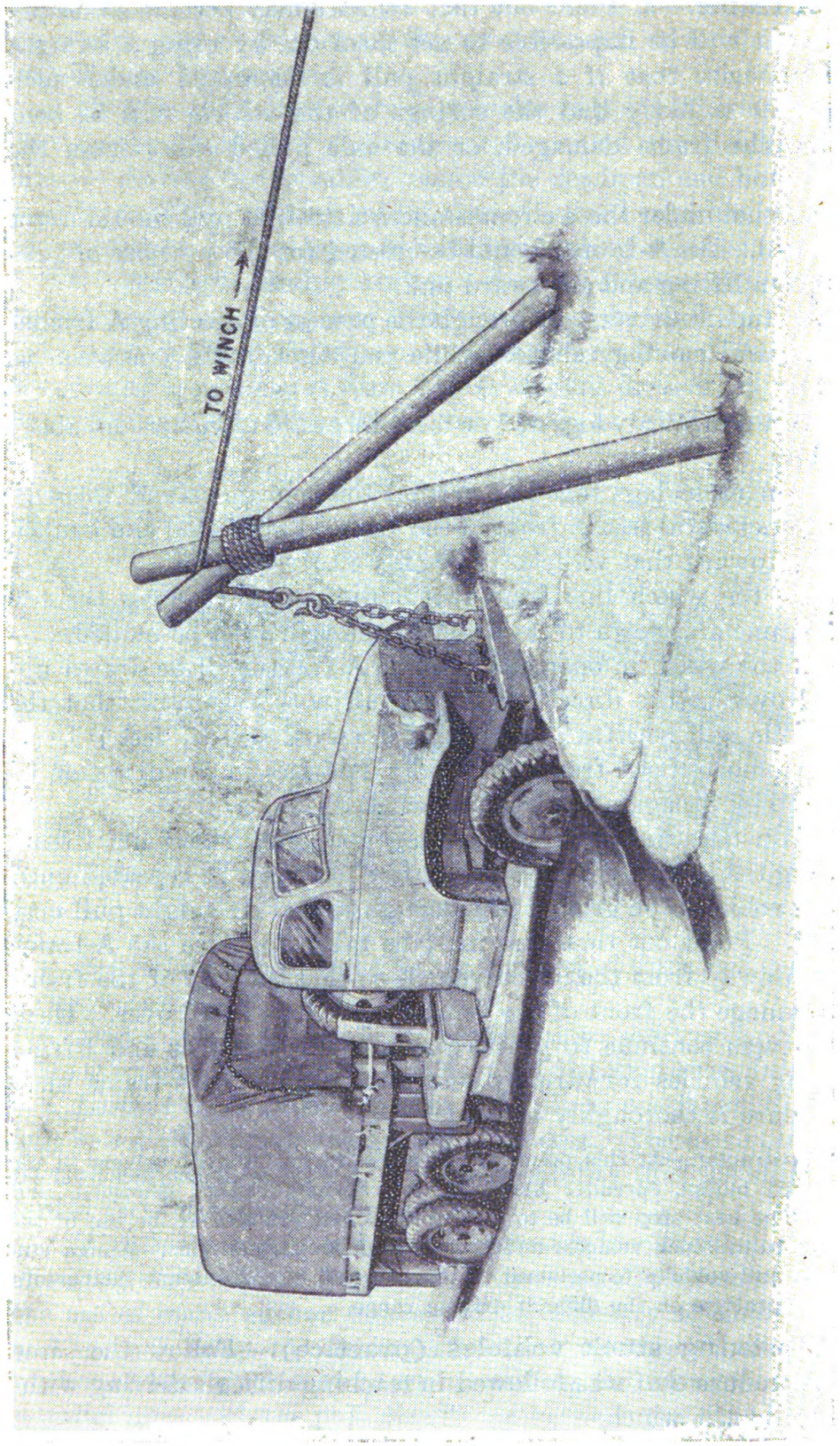

FIGURE 39.—A-frame.

a. Have students practice rescuing stuck vehicles with the following types of pulls:

(1) Straight pull with the anchorage ahead of the vehicle, using no snatch block.

(2) Straight pull with the anchorage ahead of the vehicle, using a snatch block fastened to the anchorage and the cable run through the snatch block and back to the vehicle.

(3) Straight pull in rescuing a second vehicle, the rescuing vehicle being equipped with the winch.

(4) Angle pull to rescue a second vehicle using a snatch block affixed to an anchorage.

(5) Use of an A-frame to lift and haul a stuck vehicle ahead.

b. Have student drivers select situations in which vehicles will become stuck. Make sure, however, that these situations are such that in miring and rescuing stuck vehicles, no damage will result.

c. Have student drivers check to make sure that there is adequate anchorage for the winch chain and hook and that in cases where an angle pull is to be made, there is adequate anchorage for the snatch block.

d. If student drivers select situations where pulls should not be made, point out the reasons why in such situations it would be difficult or undesirable to attempt to rescue vehicles in emergency.

e. Have student drivers perform whatever pioneer work and rigging of equipment (anchorages, snatch blocks, winch cable, A-frame, etc.) is necessary in the situations where practice is to be undertaken.

f. Check pioneer work and rigging of equipment, and point out and correct all errors before permitting student drivers to attempt pulls.

g. Make sure that all persons are clear of winches and cables before permitting pulls. Point out that a breaking winch cable may cause serious injury.

h. In some situations have student drivers operate the winch while you give instructions. In other situations operate the winch yourself while student drivers give instructions. In both cases point out all student-driver errors and the procedure which should have been followed. Continue practice until student drivers are proficient.

303. Improvising a winch by means of ropes and dual wheels.—*a.* Assemble student drivers and explain that if a vehicle that is not equipped with a winch becomes mired, a winch may be improvised by using two strong ropes. Point out that usually there are several 1-inch ropes provided on wreckers or other motor vehicles in a motor march or convoy operating in difficult terrain.

b. Have assistant instructor demonstrate while you explain, as follows:

(1) Obtain two ropes strong enough to withstand the pull required and long enough so that each will reach from an axle of the mired vehicle to a solid anchorage.

(2) Fasten one of these ropes around the axle between the tires of a dual wheel so that when the wheel turns, the rope will wind around that part of the axle.

(3) In the same manner, fasten the other rope on the opposite end of the same axle.

(4) Extend both ropes to the anchorage and fasten them so that they will be equally taut before the pull is started.

(5) Shift into the desired gear and operate the driving wheels so that the ropes will be wound upon the axles and the vehicle will be pulled out of the mire.

c. Explain that it is necessary to use two ropes, one on each dual wheel on a single axle. If only one rope is used on one dual wheel, the opposite wheel will merely spin when power is applied and no winching effect will develop.

d. Explain that the pair of ropes may be attached to dual wheels on either the rear axle, the rear axle in a tandem bogie, or the front axle if the vehicle is equipped with front-wheel drive.

e. Add that if it is desired to make the pull with front driving wheels and there are only single wheels on front axles, they must be made into dual wheels by bolting on the spare wheels before this operation is attempted. (This, however, will be very difficult if the vehicle is deeply mired.)

f. If time permits, assign student drivers and vehicles to assistant instructors and have them practice until proficient in the use of ropes as an improvised winch under difficult driving conditions.

K—EMERGENCY FIELD EXPEDIENTS

304. General.—*a. Objective.*—To provide student drivers with a basic knowledge of minor repairs that they may have occasion to make in an emergency when operating "on their own"—such repairs being limited by the tools and materials that are part of the equipment of the vehicle or that may readily be improvised.

b. Place.—In the field.

c. Personnel.—One assistant instructor.

d. Materials.—One vehicle, tire tape, chewing gum, prepared cement, plastic gasket material, bits of cloth, running board or floor matting, sawdust, oatmeal, soap, wire.

e. References.

Motor Transport School Text No. 16, Military Motor Transportation.

TM 10–460, Driver's Manual.

305. Introductory remarks.—Assemble student drivers, one vehicle, and one assistant instructor in the field and make brief introductory remarks, explaining the advantage of being skilled in emergency repairs and ingenious in devising ways of making such repairs. The following is an effective manner of procedure:

a. Point out that under war conditions, it is not always possible to summon a mechanic to fix anything from a flat tire to a leaking oil pan, as is the case in civilian driving.

b. Stress that the driver who neglects to learn all the useful tricks by which he can make emergency repairs to his vehicle may some day, as a result of such neglect, fail to reach his destination and perhaps be the cause of many lives being lost.

c. Emphasize that the emergency expedients you will now explain and demonstrate should be made only in emergency, and that after making emergency repairs, if they can be made, the trouble should be reported to a superior for proper repair at the earliest opportunity.

d. Stress that not all the materials mentioned will be on the vehicle, but that some of them may be procured in the vicinity in the event of a breakdown.

e. Stress again that the driver, after making such emergency repairs as he is able, must not forget to have the proper repairs made later.

306. Leaky radiator.—*a.* Tell students to imagine that the radiator of the demonstration vehicle is leaking in several specific places. (Point out places.) Ask students what materials may be carried on vehicles to stop radiator leaks. (Prepared cement, gasket-making material, etc.)

b. Ask students to produce whatever materials they have handy on their person that they think might stop radiator leaks. (Chewing gum, bits of cloth, etc.)

c. Ask students what materials may be put in the radiator itself to stop leaks in an emergency. (Sawdust, etc.) Have assistant instructor demonstrate various methods of temporarily sealing leaks. (Do not have assistant instructor put anything in the radiator. Explain that substances put in the radiator, while they will help to stop leaks, will also clog the radiator and should therefore be used only in a serious emergency.)

d. Point out that after making emergency radiator repairs, water must be put in radiator to bring water level to correct height. Stress

the importance of making frequent checks of emergency repairs and of water level in radiator while vehicle is in use.

e. Stress that after repairing a leaky radiator in cold weather, a sufficient quantity of antifreeze must be added in addition to water, otherwise mixture in radiator will freeze.

307. Cracked water jacket.—Have assistant instructor demonstrate correct method of temporarily repairing a cracked water jacket by pressing plastic gasket material, sealing wax, or some other adhesive material over the crack. Ask students to name all the substances they can think of that might be used in emergency to make this type of repair.

308. Leaky hose.—Have assistant instructor demonstrate correct method of temporarily stopping a hose leak by taping with wire tape or adhesive tape.

309. Leaky or broken oil pan.—Have assistant instructor remove oil pan and demonstrate emergency repair of small leaks by the use of plastic gasket material or sealing wax. Also show how to repair broken oil pan by bolting over the break a gasket made of leather or rubber matting used on running board or in floor mat.

310. Leaky or broken fuel lines.—Have assistant instructor trace course of fuel line from gasoline tank to carburetor. Then, demonstrate how to repair breaks by covering them with plastic gasket material, binding them with tape lashed tightly with fine wire, or by slipping sections of close fitting rubber tubing over the ends of the break.

311. Broken valve springs.—On a vehicle with engine running, have assistant instructor remove valve rocker-arm cover and point out the action of the valve springs. Explain function of springs to men. Ask how springs would fail to function if broken. Ask men to suggest how they think a broken valve spring may be temporarily fixed. Shut off engine and demonstrate how flat washers placed between the broken parts will temporarily fix the valve spring.

312. Broken leaf springs.—*a.* Point out and explain how a broken or sagging leaf spring would permit the chassis of the vehicle to sag down upon the axle. Serious damage might result from this, particularly when driving over bumpy terrain.

b. Have assistant instructor demonstrate by use of a pry bar and by placing a block of wood or other material between the spring and the axle, how spring action and axle displacement may be prevented.

c. Emphasize that after broken or sagging leaf springs have been temporarily fixed, vehicles should be driven very slowly. Drivers should avoid driving over road bumps until permanent repairs have

been made. Emphasize that spring trouble usually will not occur if drivers do not overload vehicles.

313. Fan belt problems.—*a.* Describe and have assistant instructor demonstrate how to replace a missing or useless flat fan belt with a web waist belt fastened with wire or how to replace a V-shaped belt with a section of rope.

b. Have assistant instructor demonstrate how a slipping fan belt can be tightened by wrapping it with friction tape.

c. Stress that the water level in the radiator should always be checked after repairing the fan belt, and water (and antifreeze) added if necessary before driving.

314. Blown fuses.—*a.* Ask the question: What is the purpose of fuses in motor vehicle electrical circuits? Ask a student driver to point out the fuses in the demonstration vehicle.

b. Point to the burned-out section in metal strip inside fuse. Emphasize that failure of an electrical circuit may not be due to fuse failure, and that drivers should be certain that fuse is blown before replacing.

c. Have assistant instructor remove and replace fuse. Mention that if no fuses are available, the circuit may be restored in an emergency by wrapping tin foil or some other conductor around the fuse. Ask why this is dangerous and never to be followed unless it is absolutely necessary that the vehicle keep moving. (Fire hazard.)

315. Short circuits.—*a.* Ask the question: What are the causes of short circuits? (Water on wiring, loose or broken wiring, wiring with worn insulation, etc.) Ask how short circuits may be repaired. (By drying the wires and nearby metal parts, by tightening connections and splicing wires, by taping insulation.)

b. Have assistant instructor demonstrate how to dry spark plugs and distributor head, distributor, and coil terminals.

c. Have assistant instructor demonstrate how to repair wires and connections with tape or other nonconductor. Have students ask questions. Clarify all points not clear to them.

316. Vapor lock.—Explain that the heat from the engine or exhaust manifold may sometimes cause gasoline in the supply line to vaporize before reaching the carburetor with the result that the engine will not run. Point out that this trouble can be corrected by merely waiting for the hot fuel line to cool, or, if the vehicle must be kept moving, by pouring cold water over the line, making sure that water does not touch the electrical system. (Application of a cool wet cloth may also be helpful.)

317. Run-down battery.—Ask the question: How would you start a vehicle with a run-down battery? (By hand cranking, or by placing in gear, and then having vehicle towed by another vehicle or pushed manually until moving at a fair rate, at which time the clutch pedal should be let out gradually.) Emphasize that a vehicle with a run-down battery should never be pushed by another vehicle unless extreme care is taken to prevent damage. Then once the engine is started, it should not be stopped unless absolutely necessary until the vehicle has reached its destination. Stress that after the engine is started, the ammeter should be checked to see if the battery is charging. Emphasize that if the battery is not charging the vehicle should not be driven unless it is absolutely necessary that it be kept moving. If there is no necessity for keeping the vehicle moving, the vehicle should be driven out of the path of traffic, and a superior notified of the trouble.

L—DRIVING IN THEATER OF OPERATIONS

318. General.—*a. Objective.*—To acquaint drivers with precautionary measures which will help them to get to their destination safely, even though subject to attack by the enemy; to provide information concerning steps to be taken when destruction of vehicles is necessary to prevent total or partial acquisition by the enemy.

b. Place.—Classroom and in the field.

c. Personnel.—One chief instructor.

d. References.

FM 25–10, Motor Transport.
FM 100–5, Operations.

319. Theater of operations; Definition.—Write on the blackboard: Theater of Operations. Ask men what, in their opinion, is meant by this expression. After you get their ideas and discuss them a bit, give the following definition: A theater of operations is an area of the theater of war necessary for military operations and the administration and supply incident to military operations. The War Department designates one or more theaters of operations.

320. Hazards in theater of operations.—*a.* Ask the student drivers the question: What are the hazards which must be guarded against while driving in the theater of operations? (Enemy shellfire, bombing, aerial and infantry attack, guerilla warfare if in enemy territory, sabotage of vehicles and cargo, the possibility that communications, maintenance, and other services may not be maintained.)

Make sure that all of the above hazards are covered, either by your own explanation or in the classroom discussion.

b. Ask the question: Why are vehicles and drivers exposed to these hazards? (Because it is so important that troops and cargo arrive at a selected destination at a specified time.)

c. Ask the question: What is the first and only objective of the driver when driving in the theater of operations? (To get to his destination on time, with his vehicle and cargo intact or damaged as little as possible by enemy action.)

321. Importance of obeying orders.—Ask the question: Why is it important that drivers obey every word of the orders given to them before being sent on a specific mission in the theater of operations? (Because their superior officers have carefully calculated all the risks involved and have worked out a plan that offers the best chance for drivers and their vehicles to get through and achieve their objective safely.)

322. Protective obscuration and camouflage.—Point out that the increased use of airplanes and ground observation posts in modern war requires extensive camouflage efforts in order to provide protective concealment for matériel, vehicles and troops from enemy observation.

a. Point out that camouflage can be accomplished by any one or more of the following general methods (described in detail in FM 5–20):

(1) *Hiding.*—Completely concealing an object by constructing overhead cover or lateral screening.

(2) *Blending.*—Making an object indistinguishable from its surroundings by breaking up its form and shadow.

(3) *Deceiving.*—Using dummies to mislead the enemy, or making an object appear to be something else.

b. Mention that the fundamental requirements for successful camouflage are, in order of importance:

(1) Proper choice of position.
(2) Good camouflage discipline.
(3) Proper erection of camouflage material.
(4) Proper choice of camouflage material.

c. Inform the men that there are a great many things the driver can do to protect his vehicle from enemy aircraft when he parks it in a theater of operations. All these are based on either concealing the vehicle or making it blend in, as much as possible, with the environment.

d. Point out the measures, designated by the commanding officer, which should be taken to conceal indications of vehicle movement that might make them a target for enemy aircraft. These measures are responsibilities of drivers and include—

(1) Utilizing available cover, such as trees, buildings, banks, etc.

(2) Parking in scattered and irregular formations.

(3) Avoiding grouping of vehicles at all times.

(4) Keeping nonessential movement at a minimum.

(5) Avoiding halts at the start of a march or prior to going under cover at the termination of the march.

(6) Using lights at night only when directed to do so, and in accordance with directions.

(7) Removal of vehicle tracks, particularly at the entrance to woods or other localities where the trucks are halted.

e. Point out that camouflage materials are of two classes: natural and artificial.

(1) Natural materials include green vegetation (grass, foliage, branches in leaf, sod, etc.) and dry vegetation (dead leaves, bare brush, etc.).

(2) Artificial materials include fish nets garnished with oznaburg, burlap or like material, garnished chicken wire.

f. Emphasize that it is the responsibility of the driver, in accordance with instructions, to camouflage vehicles and to maintain artificial camouflage, repairing it when necessary, and keeping it up to date by changing its appearance or color as that of the terrain changes with the season. The camouflage officer will guide this work.

g. Point out that whenever possible the driver should—

(1) Use natural camouflage.

(2) Park so shadows will not give away the presence of the vehicle.

(3) Park close against a barn or house, so that it appears as part of the building.

h. Point out that in order to prevent reflection the driver should—

(1) Cover headlamps with burlap, articles of clothing, or mud.

(2) Lower windows.

(3) Cover windshield with a blanket or shelter half.

(4) Cover spot reflectors and taillights with a pack of mud, or with cloth.

i. Point out that Army vehicles are (or will be) equipped with a pregarnished camouflage net, which may be altered in color by spraying or by changing garnish. This net is to be used for camouflage purposes in open areas, or to augment natural obscuration.

j. Explain that drivers will be responsible for setting up camouflage nets and should therefore understand the best and most effective way to do this.

k. Have an assistant instructor and three student drivers demonstrate the correct method for setting up a net over a truck. While they demonstrate, explain to the group the important points which should be noted concerning this procedure. Point out, in this connection, that the heavily garnished portion of the net is to be placed so that it is directly over the vehicle. Indicate, also, how poles (or limbs of trees) are used to keep the net up and in proper position. Have the assistant instructor and student driver demonstrate the correct method of folding the net. (This operation requires eight men, if it is to be done quickly and efficiently.) Have students practice setting up nets over their vehicles and the folding of these nets. Following this, have student drivers practice camouflage using natural materials which are available in the locality.

323. Night driving.—Point out that most motor vehicle movements may have to be made at night. Instructions pertaining to night driving and driving under blackout conditions should be followed. (See Unit 4C and E, for information pertaining to night and blackout driving.)

324. Bivouac and assembly areas.—Lead off the discussion by explaining what is meant by a bivouac. (A bivouac is a temporary encampment under improvised shelter or with no shelter, often when in danger of surprise attack.) Explain that large wooded areas and towns make the best assembly areas. Point out that these areas should be large enough to accommodate units in dispersed formation with a minimum of 75 yards between vehicles. Congestion is a constant source of danger.

325. Necessary destruction of vehicles.—*a.* Point out that in the combat zone it may be necessary to destroy vehicles to keep them from falling into the hands of the enemy. Emphasize that in such cases it is essential not only that the enemy be kept from acquiring a vehicle in running condition, but also that they be prevented from acquiring oil, gasoline, and any vehicle parts that can be repaired or employed in rebuilding other vehicles.

b. Point out that these objectives may generally be accomplished in two ways: Running fatigue, and fire. Ask the students what they think is meant by running fatigue and what procedures should be followed in this connection. Ask the students what steps they would take in producing the most effective destruction of the vehicle by fire. Summarize correct replies to these questions and point out that, when

destruction of the vehicle must be accomplished quickly, steps should be taken in the following order:

(1) Fire a shot through the top of the crankcase and through the bottom at its lowest point. (It may be possible to make satisfactory punctures with a bayonet or with a pick mattock or axe, which are parts of the present pioneer equipment sets. Draining the crankcase by removal of the oil plug may require too much time.)

(2) Fire some shots into the radiator.

(3) Start the engine and run it with throttle wide open so that seizure of parts will result.

(4) Puncture the bottom of the gasoline tank with an upward blow of the pick mattock. If possible saturate the tires and ground underneath the vehicle with gasoline.

(5) At fairly close range, fire a shot into the gasoline tank or ignite the gasoline in some other way that will not endanger yourself and others. The resulting fire should do very considerable damage, if not effect complete destruction of the vehicle and its cargo.

c. Point out that where time permits, it is desirable to carry out additional steps such as the following:

(1) Remove plugs from all major units and break casings to allow liquid to escape.

(2) Slash tires before saturating them in gasoline.

(3) Break up carburetors, distributors, and cast parts with ax.

(4) Saturate inside of cab and other vital parts of vehicle with gasoline before igniting vehicle.

(5) Puncture liquid containers with ax or pick mattock and ignite.

d. Point out that in the case of vehicles whose engines are not running, it is desirable to crack the engine block and head, carburetors, fuel pump, generator, and starter.

e. Emphasize that vehicle loads as well as vehicles must be destroyed, so that no article of the slightest use will be allowed to fall into enemy hands.

M—TRAILER UNITS

326. General.—*a. Objective.*—To develop in student drivers the ability to attach, disengage, and park semitrailers, trailers, and full trailers; and the ability to drive and maneuver vehicles while towing trailers.

b. Place.—On driving range or field.

c. Equipment.—One semitrailer, one trailer, one full trailer, one tractor equipped with lower fifth-wheel mounting, and one truck equipped with pintle for demonstration purposes. A sufficient num-

ber of all these types of vehicles are necessary so that student drivers can get adequate practice in the time allotted.

d. Personnel.—A minimum of two assistant instructors to demonstrate as you explain. If available, a sufficient number of assistant instructors so that you can assign each student driver to an assistant instructor in field practice.

e. References.

TM 10–560, Chassis, Body, and Trailer Units.
TM 10–460, Driver's Manual.
Manufacturer's Maintenance Manuals for vehicles used.

f. Note to instructor.—The operation of trailer units is usually a more or less specialized activity. However, the average driver should be familiar with characteristics of trailers, with methods of attaching and disconnecting trailers, and with handling the landing gear. It is desirable, also for him to have some knowledge of the basic principles of towing, backing, and parking trailers. In the event of an emergency he may be required to utilize such knowledge. Generally, actual practice of those operations should be reserved for special students who are to be trained as tractor-trailer operators. It is suggested, therefore, that the practical instruction described in paragraphs 338 through 345 be given only to such prospective operators, unless time and other local conditions permit a different procedure. The principles behind this practical instruction may, however, be presented to all student drivers.

327. Types of trailers.—Assemble student drivers, two assistant instructors, and demonstration vehicles in field. Explain that there are three types of trailers: semitrailers, trailers, and full trailers. Briefly point out the various types of trailers and the method of connecting trailers to towing vehicles as follows:

a. The engine power and traction of military motor vehicles is so great that most of these vehicles are perfectly competent to pull other vehicles under most driving conditions.

b. A trailer is a cargo vehicle with no motive power of its own and must therefore be towed by another vehicle (tractor or truck).

c. A tractor is merely an engine and controls mounted on driving wheels or tracks and used solely to haul trailers of various types.

d. A truck, on the other hand, is provided with its own space for cargo. When hauling a trailer, the truck serves as the source of motive power for a two-vehicle train. Any vehicle which is capable of transporting cargo and also hauling another vehicle is called a "prime mover."

328. Semitrailers.—Assemble student drivers about a semitrailer and point out that this type of vehicle has only two rear wheels plus a retractable landing gear to serve as a support when the semitrailer is parked without its tractor. Explain securing semitrailer to tractor by means of the fifth-wheel plate as follows:

a. Point out that when being hauled, the weight of the semitrailer is supported by the two wheels and by the fifth-wheel locking device. This fifth wheel consists of two metal plates, one on the trailer and one on the tractor, by which the semitrailer is secured to the hauling tractor.

b. Point out the lower fifth-wheel plate on the tractor. Briefly mention that when the tractor and the semitrailer lock together, the upper fifth-wheel plate on the semitrailer and the lower fifth-wheel plate on the tractor form a coupling. This coupling is capable of supporting the weight of the front of the semitrailer when the semitrailer is being hauled.

c. Point out that all types of trailers equipped with upper fifth-wheel plates can be hauled only by tractors as no trucks are equipped with lower fifth-wheel plates.

d. Mention that later, when you demonstrate connecting semitrailers to tractors, you will describe the fifth-wheel plate method of connection in full detail. Say that at present you are interested only in pointing out the various types of trailers.

329. Trailers.—Assemble student drivers about a trailer and point out that this trailer differs from the semitrailer because it has no upper fifth-wheel plate. Use the term "trailer," as contrasted with the semitrailer you have just shown, and have a student explain the difference between those two types of trailers. (Trailer has no upper fifth-wheel plate.)

a. Method of connecting trailers to towing vehicles.—Point out the method by which trailers are connected to towing vehicles. One may use a lunette which consists merely of an eye at the front end of the trailer. The eye is slipped over and locked to a pintle on the rear of the hauling vehicle. Another method may use a tow-bar arrangement designed to support considerable weight and affixed to the towing vehicle by the previously described lunette and pintle.

b. Landing gear.—Explain that trailers may be equipped either with a type of landing gear similar to that pointed out on the semitrailer, or with a landing gear which consists merely of an additional, retractable wheel.

c. Safety chains.—Point out the safety chains which are designed to hold the towed vehicle in case of breakage in the lunette and pintle

connections. Emphasize that these chains should always be fastened when hauling towed vehicles.

330. Full trailer.—Assemble student drivers about a full trailer and state that the third type of trailer is the "full trailer." Explain that the full trailer differs from the semitrailer and the trailer in the respect that it always has enough wheels for self-support in a level position regardless of the towing vehicle. Add that full trailers need no landing gear. State that the connection between the full trailer and the towing vehicle is made only by the pintle-lunette arrangement, as no fifth wheel is required to support the front end of the full trailer.

331. Braking system on trailers.—Add that trailers of all three types may or may not be equipped with braking systems, but that most trailers with more than two wheels are equipped with air or electric brakes.

a. Air and electric brakes.—Explain that both air and electric brakes on trailers are usually operated from a control in the cab located on the steering post.

b. Controlling braking force.—Explain that the braking force exerted by air brakes may be regulated by the extent to which the trailer hand brake in the cab is engaged. Point out that the braking capacity of electric brakes should be adjusted by the driver in conformity with the trailer load before operating the combination. (This is done by the load control knob. The controller is not sensitive enough to regulate the braking effort through the full range of vehicle loading.) Point out the braking systems on some of the demonstration trailers and the brake couplings to the tractors.

c. Brake controls.—Point out the trailer brake controls in the cabs of the hauling vehicles. Explain and demonstrate their use.

d. Coordinating vehicle and trailer.—Emphasize that when stopping a trailer equipped with brakes, the driver should apply the trailer brakes by the hand control in the cab just before applying the foot brake of the tractor. If this is done properly, the trailer will not jackknife or otherwise pile up on the towing vehicle. Demonstrate and explain proper method of coordinating trailer and tractor brakes. Point out that there will be considerable practice later in stopping trailers so that drivers will learn how to coordinate properly the brakes of the trailer with those of the tractor. Emphasize the necessity for applying the brakes of the tractor very gradually and carefully when towing a trailer which is not equipped with trailer brakes.

332. Dolly.—Assemble student drivers about a dolly. State that semitrailers may be converted into full trailers by mounting the fifth

wheel of the semitrailer on a dolly which is essentially a two-wheeled trailer chassis with a standard lower fifth-wheel plate mounted on its frame. Point out that the front end of the dolly frame is equipped with a lunette for towing the dolly trailer combination by a pintle hook on the towing vehicle.

333. Handling landing gear.—Have an assistant instructor back a tractor to a position a few feet ahead of a semitrailer and assemble student drivers about these vehicles. Point out and explain the mechanisms of the landing gear and the fifth-wheel plates on the semitrailer and the tractor as follows:

a. The legs of the landing gear are attached to the under side of the trailer chassis by pins, and may be drawn up under the trailer so that the landing gear will be out of the way while the trailer is being hauled. This is done by turning the crank on the side of the trailer frame.

b. The height at which the front end of the semitrailer can be raised above the ground is regulated by adjustable clamps at the top of the legs of the landing gear. Such adjustment is necessary whenever the trailer is to be used with a hauling vehicle having a different rear-end height.

c. When the trailer is parked, the landing gear should be fully lowered. If not, it might buckle, with the result that the front end of the trailer would drop to the ground.

d. When the trailer is being hauled, the landing gear should be fully retracted and locked in place.

334. Upper and lower fifth-wheel plate.—The upper fifth-wheel plate is equipped with a king pin. As the hauling vehicle is backed so that the lower fifth-wheel plate is beneath it, the pin will be guided by sloping ramps into the king-pin lock located in the lower fifth-wheel plate. The lower fifth-wheel plate is installed on a rocker shaft which provides a flexible connection between the hauling vehicle and the semitrailer after the two vehicles are locked together. This shaft tilts as the hauling vehicle is backed into locking position; it also tilts when the combination is operated on uneven ground.

a. Care of lower fifth-wheel plate.—When the two vehicles round a curve, the upper and lower fifth-wheel plates turn against each other; therefore, the lower fifth-wheel plate must always be kept well greased.

b. Locking mechanism.—The automatic locking mechanism on the lower fifth-wheel plate locks the king pin on the semitrailer into the socket on the lower fifth-wheel plate. This prevents vehicles from be-

coming disengaged while the semitrailer is being hauled. The locking device should be tested to make sure it is holding securely.

c. Unfastening semitrailer.—Explain and demonstrate the method of disengaging the king-pin lock when unfastening semitrailer.

d. Connecting vehicle to semitrailer.—Point out that to connect a vehicle to a semitrailer, the hauling vehicle must be backed until the king pin on the semitrailer is locked on the lower fifth-wheel plate on the tractor. When this is done, the upper fifth-wheel plate on the semitrailer must be at approximately the same height as the lower fifth-wheel plate on the tractor. The reason for this is that the king pin will contact the guiding slot in the lower fifth-wheel plate and slide into place as the hauling vehicle is backed. State that if the upper fifth-wheel plate on the semitrailer is too high, the landing gear should be retracted enough to permit connection as the vehicles are brought together. Add that if the upper fifth-wheel plate on the semitrailer is too low (which may happen if the ground where the trailer is parked is muddy, etc.), the front end of the semitrailer must be jacked up to the proper height before connection can be made. (For parking hints, see par. 15.)

335. Connecting and disconnecting trailers with fifth wheel.—*a.* Have an assistant instructor regulate the height of the fifth-wheel plate on the semitrailer so that the connection can be made. Then have an assistant instructor back towing vehicle into semitrailer until vehicles are locked together. Test the connection. Point out brake and electrical connections between semitrailer and hauling vehicle and connect them while you explain each step in making the connections.

b. Select a student driver and have him retract and lock the landing gear on the semitrailer as you instruct him. Have the other students watch the procedure. Have an assistant instructor drive the combination ahead a few feet and stop. Select another student driver and have him lower the landing gear on semitrailer while you instruct him. Have the other student drivers watch the procedure.

c. Continue this procedure. Select a student driver and have him perform the following operations while other student drivers watch:

(1) Disconnect brake couplings.

(2) Disconnect electrical couplings.

(3) Release the automatic king-pin lock of the lower fifth-wheel plate so that vehicles may be disengaged.

d. Have an assistant instructor drive tractor a few feet ahead and stop. Ask for questions and clarify any points not clear. Now as-

sign student drivers to assistant instructors and have student drivers practice backing the towing vehicle until king-pin connection is made. Have them practice raising landing gear, connecting brake and electrical couplings, driving ahead a few feet and stopping, lowering landing gear, releasing king-pin lock, and driving vehicle ahead a few feet and stopping. Throughout this practice, have assistant instructors give student drivers whatever directions are necessary, and point out and correct all errors.

336. Connecting and disconnecting trailers with lunette and pintle.—Assemble student drivers about a trailer equipped with lunette for connecting to towing vehicle. Have student drivers practice attaching and disconnecting trailers by means of lunette and pintle, and have them practice retracting and lowering landing gear or landing-gear wheel.

337. Converting semitrailers into full trailers.—If dollys are available and time permits, have student drivers practice converting semitrailers into full trailers by backing and locking the dollys under the upper fifth-wheel plates on the semitrailers.

338. Towing trailers.—Be sure student drivers are thoroughly familiar with the procedure for attaching, disengaging, and parking semitrailers, trailers, and full trailers, using both the lunette and pintle and the upper and lower fifth-wheel plate methods. Then have them practice driving vehicles to which are attached various trailer combinations as follows:

NOTE.—This practice is to be carried out on the driving courses shown in figure 20.

a. Making turns.—Have student drivers drive around square (fig. 20A) making left turns and then right turns. Continue this practice until student drivers are able to negotiate a 90° turn either to right or left. They should become so proficient that when driving on streets and highways the towed vehicle will not mount the curb or leave the road.

b. Driving between obstacles.—With barrels or other obstacles arranged as shown in figure 20B, have student drivers practice driving in and out between obstacles until they can do so without striking them either with the towing or the towed vehicle.

339. Backing a trailer.—Before commencing the next stage of practice instruct student drivers in the correct way to steer towing vehicles when backing up. Emphasize the following:

a. When backing a trailer directly to the rear without any guidance by an assistant on the ground, the driver usually stands with one

foot on the running board and keeps looking toward the rear so that he can see the direction of travel of the tractor-trailer combination. He operates very slowly in reverse, adjusting the steering as necessary.

b. When backing a trailer to the left, the driver turns his steering wheel to the right (so that the towing vehicle will back to the right, swinging the rear of the trailer to the left), until the trailer is heading in the desired direction. Then the driver quickly turns the wheels of the tractor to the right, to put the tractor in the same line of travel as the trailer. (The opposite procedure is followed in backing a trailer to the right.)

c. Demonstrate and then have student drivers practice backing trailers until they can back them straight to the rear, then to the right and to the left, first with and then without outside guidance. Have them continue this practice until they can back a trailer so that the center of its rear axle will be above a point on the ground not more than two feet away from a spot previously marked by the assistant instructor (spot-parking).

340. Backing and parking in alinement.—Instruct the student drivers that when backing and parking trailers in alinement (as shown in fig. 20C) they must allow considerable space to get into the preliminary position that will enable them to back the trailers into line. Point out that it is extremely difficult to back and park a trailer in alinement properly without guidance, and that an assistant on the ground in front of the vehicle should guide the driver in the cab. Have a group of student drivers guide the other student drivers in all backing-parking practice. Have the student drivers practice parking in alinement and backing as shown in figure 20C and D.

341. Hints for safe operation of trailers.—At the close of practice, assemble student drivers and give them the following hints for safe operation of trailers on the streets and highways:

a. Added load.—The driver must always bear in mind that the trailer represents an added load on the tractor's engine and brakes.

b. Trailer height, weight, and braking capacity.—The driver should know the height, the gross weight, and the braking capacity of the trailer he is hauling, so that he may be able to operate safely over bridges, in tunnels, on slippery ground, etc.

c. Trailer lights.—Before hauling a trailer at night, the driver should make sure that the trailer's taillights and markerlights are working and turned on, and that the trailer's stoplight is working.

d. Ascending grades.—When ascending a grade, the driver should shift to a gear ratio in time to permit the engine of the tractor to tow

the total load without strain. If the vehicles are equipped with a tachometer, instructor should tell students how to use it as a guide in selecting the proper gear ratio.

e. Descending grades.—Before descending a grade, the driver should shift into the same gear ratio which he would use in hauling the trailer up a grade of the same angle. If there is any tendency of the trailer to jackknife from side to side, he should apply the trailer brakes enough so that the trailer will pull back on the descent. If the trailer starts to jackknife in descending a grade and the jackknife tendency cannot be readily stopped the driver should speed up the hauling vehicle to a point where the trailer swings back in line.

f. Changing speeds.—The driver should make all changes of speed gradually and smoothly. By doing this, he will minimize danger of the trailer jackknifing.

g. Rounding curves.—When rounding curves, the driver should take precautions so that neither the trailer nor the tractor will leave the firm surface of the road. On sharp curves, it may be necessary to back and fill several times to get the combination around the curve.

h. Parking a trailer.—The air-brake system used on trailers is so constructed that after a trailer is parked and the brake couplings to the hauling vehicle are disconnected, trailer brakes will continue to hold only for a limited time. Therefore, blocks should be used to hold the trailer wheels in place when a trailer has been parked. In the case of a trailer equipped with electric brakes, the brakes will continue to hold.

i. Parking a trailer on soft ground.—If a trailer is to be parked on soft ground and disconnected from the hauling vehicle, its landing gear should be let down on two planks to prevent it from sinking into the soft ground.

342. Maintenance of trailers.—Emphasize that the driver is responsible for the maintenance of his trailer, and that he should perform all the driver maintenance duties prescribed by the manufacturer. Point out that before operating a trailer the driver must—

a. Inspect and if necessary tighten all screws, nuts, and bolts.

b. Check the air pressure and condition of the tires.

c. Make sure that there is no leakage of grease from the wheel bearings which may interfere with the operation of the trailer brakes.

d. After making coupling connections between trailer and towing vehicle, check to see if electrical equipment on the trailer is working.

343. Testing trailer brakes.—Point out that when starting to haul a trailer, the driver should test the trailer brakes by driving ahead a few feet and applying them.

344. Reporting defective equipment.—Emphasize that any defective trailer equipment or parts which the driver is unable or not authorized to repair should be reported immediately to a superior.

345. Further practice.—Have specially slected students (prospective trailer operators) practice hauling trailers on the road, backing, ascending, and descending grades, and parking in alinement until they have demonstrated proficiency in these operations.

N—BREAKING IN A NEW VEHICLE

346. General.—*a. Objective.*—To acquaint student drivers with preliminary measures to be taken in operating and maintaining new or reconditioned vehicles.

b. Place.—Classroom.

c. References.

TM 10–545, Motor Vehicle Inspections and Preventive Maintenance Servicing.

Motor Transport Technical Service Bulletin No. Z–13, Reception, Inspection, and Breaking In of New Motor Vehicles.

TM 10–1505, Maintenance Manual, International 2½-ton 6 x 6.

d. Note to instructor.—Assemble student drivers in classroom and explain that there will be times when new or reconditioned vehicles will be assigned to them. Point out that before such vehicles are assigned, they will have been thoroughly checked and inspected. Add that because engine parts will be stiff, such vehicles must be driven with extreme care for at least 1,000 miles.

347. Speed precautions.—Emphasize that a new or reconditioned vehicle should not be driven faster than 25 miles an hour for the first 500 miles, or faster than 35 miles an hour for the second 500 miles in high range, and at proportionately lower speeds in low range. State that the engine should at no time be raced or forced to deliver its maximum power, and that shifting of all gears and accelerating, decelerating, and braking should be done smoothly and gradually.

348. Maintenance schedules.—Point out that in maintaining a new vehicle, the driver must—

a. Perform Preventive Maintenance Schedules Nos. 2, 3, 4, and 5 daily, and No. 6 weekly during the first 500 miles of operation. (It is desirable, after operation of the vehicle for several hours, for the oil to be drained from the crankcase and replaced with clean oil while the engine is hot. Failure to change oil may result in metal filings scoring the engine parts, chemical action damaging engine parts, and

insufficient lubrication due to the fact that excessive temperature in the new motor causes rapid breaking down of the oil.)

b. Remind his superior that the crankcase should be drained after the first 500 miles of operation, and refilled with fresh oil while the engine is hot.

c. Perform PMS. Nos. 2, 3, 4, and 5 daily and No. 6 weekly during the second 500 miles of operation.

PREVENTIVE MAINTENANCE SCHEDULE - WHEELED AND HALF-TRACK MOTOR VEHICLES

PMS #7 MONTHLY OR 1000 MILE WHICHEVER OCCURS FIRST

SECOND ECHELON

PMS #8 SEMI-ANNUAL OR 6000 MILE WHICHEVER OCCURS FIRST

(DRIVER SHOULD ACCOMPANY MECHANIC AND ASSIST WHEN POSSIBLE)

PURPOSE: TO PERFORM LUBRICATION, INSPECTIONS AND SERVICES THAT WILL CORRECT DEFICIENCIES LIKELY TO INTERFERE WITH DEPENDABLE OPERATION DURING THE NEXT MONTH (OR DURING THE NEXT SIX MONTHS FOR THE SEMI-ANNUAL)

LEGEND: ✓ for "Satisfactory" O for "Not Satisfactory."

VEHICLE RECORDS		7/8-11. Brake hydraulic system	
7/8-1. Repairs since previous Monthly or Semi-Annual PMS (From Vehicle Service Record Book, W.D., QMC Form No. 248)		7/8-12. Brake air system	
7/8-2. Oil mileage - (From summary of gasoline and lubricant issue slips, W.D., QMC Form No. 231)		7/8-13. Brake vacuum booster system	
7/8-3. Fuel mileage - (From summary of gasoline and lubricant issue slips, W.D., QMC Form No. 231)		7/8-14. Brakes: electric for trailer	
ROAD TEST AND INSPECTION		7/8-15. Steering gear and linkage	
7/8-4. "Daily-Before Operation," P.M.S. No. 3		7/8-16. Springs, shackles and suspensions	
7/8-5. "Daily-During Operation," P.M.S. No. 4		7/8-17. Shock absorbers	
7/8-6. "Daily-After Operation," P.M.S. No. 2		7/8-18. Axles and differentials	
SERVICES		7/8-19. Rollers	
7/8-7. Tires		7/8-20. Tracks, suspensions, and sprockets.	
7/8-8. Wheel bearings		7/8-21. Clutch	
7/8-9. Steering knuckles and steering linkage		7/8-22. Transmission	
7/8-10. Brakes		7/8-23. Transfer case	
		7/8-24. Propeller shafts and universal joints	
		7/8-25. Lash in gears, propeller shaft slip joints and universal joints	
		7/8-26. Engine	

FIGURE 40.—Preventive maintenance schedule Nos. 7 and 8.

d. Be present during the performance of PMS No. 7, and if possible assist the second echelon mechanic. PMS No. 7 should be done after the first 500 miles and again after the second 500 miles of operation.

7/8-27. Breather Cap		7/8-33. Oil filter	
7/8-28. Air cleaner		7/8-34. Winch and power take-off	
7/8-29. Cooling system		FINAL ROAD TEST - BY MECHANIC WITH DRIVER	
7/8-30. Tune-up: engine, electrical, and fuel system		7/8-35. "Before Operation" P.M.S. No. 3	
LUBRICATION		7/8-36. "During Operation" P.M.S. No. 4	
7/8-31. Monthly (1000 mile) Semi-annual (6000 mile) lubrication per recommendation for vehicle		7/8-37. "After Operation" P.M.S. No. 2	
7/8-32. Engine oil			

REMARKS: If vehicle must be sent to higher echelon, show explanation here of work needed, so officer responsible can approve recommendation.

Vehicle Nomenclature _____ U.S.A. Reg. No. _____

Organization _____

Station _____

Mileage _____ Date _____

Driver _____
(Signature and Rank)

Mechanic _____
(Signature and Rank)

Motor Sergeant _____
(Signature and Rank)

Supervising Officer _____
(Signature and Rank)

FIGURE 40.—Preventive maintenance schedule Nos. 7 and 8—Continued.

SECTION IV

FINAL EXAMINATION

(Tests for course and for issuance of operator's permit)

349. General.—After a student has completed the military motor vehicle operators' course, he should not only be able to handle a military vehicle skillfully but he should also know the relevant Army regulations and practices and be able to perform authorized preventive maintenance services. Three tests are provided for this purpose: an information test, an inspection test, and a road test. They should be conducted by a qualified commissioned officer or at least under his supervision. (See par. 4.) Military motor vehicle operator's permits are to be issued to individuals who pass this examination.

350. Driver information test.—Driver information test No. 2, which appears at the end of this section, is to be administered and scored in exactly the same way as the driver information test for initial selection. (See par. 7.)

351. Vehicle inspection test.—One or more trucks should be "fixed" with about five defects and five items missing, such as one headlight not working, missing fire extinguisher, oil low in crankcase, underinflated tire, disconnected spark plug, loose fan belt, windshield wiper not working, etc. The person to be tested should be given the following instructions: "You are to make an inspection of a truck. Assume you know nothing about the previous use of the truck but have been asked to drive it on a 200-mile trip. Perform the before-operation check (Preventive Maintenance Schedule No. 3) from memory and report to me." After the driver has completed his check, ask him to list the defective or missing items. If he omits any, ask him to make a second check. A second omission should be a cause for failure on the test.

352. Road test.—*a.* Study the road test checklist (Table II). Before beginning the test, carefully work out the necessary route and procedure, so that a maximum of testing may be done in a minimum of time; at least 20 minutes should be allowed for each man to be tested. If possible, a driver should be tested in the vehicle he is to drive. For general truck driving, a 2½-ton truck will be satis-

factory. The first part of the test course should be straight and level to allow the driver to become partially familiar with the operation of the vehicle. Every time an error is made it should be noted on the checklist. In some cases a given item may be checked several times during the course of the test. Observe the following procedure for the various parts of the test.

TABLE II.—*Road test check list*

Starting vehicle
1. Starts engine with gears engaged
2. Starts engine with clutch engaged
3. Fails to release hand brake
4. Kills engine in starting
5. Jerks in starting

Stopping on level
6. Engine not used for braking
7. Jerks in stopping

Use of controls
8. Does not double-clutch
9. Strains engine
10. Rides clutch
11. Clashes gears
12. Uses brake excessively
13. Tries more than once shifting fourth to third
14. Tries more than once engaging front wheel drive
15. Tries more than once engaging low range

Hand signals
16. Not given for STOP
17. Not given for LEFT TURN
18. Not given for RIGHT TURN

Stop signs and railroad
19. Goes through 0 to 5 m.p.h.
20. Goes through over 5 m.p.h.

Driving on hills
21. Goes up in wrong gear
22. Stops to shift while going up
23. Stalls engine while starting on hill
24. Jerks in starting on hill
25. Rolls back more than 1 foot in starting
26. Coasts driving downhill
27. Coasts backing downhill

Driving through mud
28. Engages front wheel drive late
29. Fails to use front wheel drive
30. Stops while in mud

Steering
31. Fails to keep to right
32. Drives off road
33. Cuts corners
34. Swings wide on turns

Parallel parking
35. Backings (over one)
36. Markers or curb hit
37. Left wheels outside parking space (1 check for each foot)

Backing to platform
38. Backings (over one)
39. Feet (over one) from platform
40. Markers or platform hit

Miscellaneous
41. Speed excessive for conditions
42. Accident
43. Near accident
44. Other errors

Final Rating

I	II	III	IV	V
Very Good	Good	Average	Poor	Failure

Comments: _____
_____
_____

(1) *Starting the vehicle.*—Before the driver gets into the truck to take the test, the hand brake should be set, the ignition turned off, the transmission in neutral, the front-wheel drive disengaged, and the transfer case placed in high range. Ask the driver to start the en-

gine and proceed down the road. Place a check mark before items 1 to 5 for any error made. Each time any of these errors is repeated use additional check marks.

(2) *Stopping on level.*—At some place in the course ask the driver to come to a stop. Check item 6 if the clutch is depressed before the brake, so that the engine is not used for braking. Check item 7 if the stop is jerky.

(3) *Use of controls.*—Observe the coordination of the driver in the manipulation of brake, clutch, gearshift, etc. throughout the test and check any errors he makes. Check item 8 if the driver has trouble in shifting because he does not double-clutch. If the driver strains the engine on a heavy pull, instead of shifting to a lower gear, check item 9. Check the other items each time an error is made. Some time during the test when the truck is in fourth gear, ask the driver to shift to third. If the shift is made on the first try, do not check item 13. However, if the driver must try more than once, use a check mark for each try in excess of 1. If the gears are clashed, check item 11. At another part of the course ask the driver to engage the front-wheel drive, and at still another place ask him to shift to low range. Use one check mark for each try necessary in excess of 1.

(4) *Hand signals.*—The test route should include at least three right and left turns. Check item 16, 17, or 18 each time a signal is omitted. If a signal is given improperly, make a note under "Comments."

(5) *Stop signs.*—The route should include at least two stop signs. Check item 19 for each one at which a complete stop is not made.

(6) *Driving on hills.*—If the terrain permits, part of the course should include steep hills and mudholes. If the driver must stop to shift while going up, check item 22. When part way up a hill, have the driver stop, shut off the engine, start again, and then proceed up the hill. Check items 23, 24, and 25 for errors made in starting. Ask the driver to back part way down a hill. If he does not use the reverse gear, check item 27.

(7) *Driving through mud.*—If the driver fails to engage the front-wheel drive *before* getting into mud, check item 28. Check item 29 if front-wheel drive is not used, even though driver gets through mud. If the driver has to stop for any reason while in the mud, check item 30.

(8) *Steering.*—Observe the steering throughout the test and check each time an error is made.

(9) *Parallel parking.*—For parallel parking, mark off a space 8 feet wide and 10 feet longer than the bumper-to-bumper length of the truck. If there is no curb, substitute a log. Use 6-foot posts, or stakes

set in kegs filled with dirt to mark the ends and corners of the space. Do not allow more than three backings. Check item 35 for each backing in excess of one, item 36 each time a marker or the curb is hit, and item 37 once for each foot of distance at which the left wheel projects outside the 8-foot limit line when parking is completed. Consider the left wheel that is farthest out of the parking space at the end of the test.

(10) *Backing to platform.*—Mark off a space 10 feet wide and extending 20 feet from a loading platform. Use posts or stanchions to mark the edges. Check item 38 for each backing required in excess of one. Check item 40 each time a marker or the platform is touched. When the vehicle is parked, measure the distance from rear bumper to platform. Place one check mark for item 39 for each foot in excess of one. If the truck were 3 feet away, two check marks would be used.

b. The test described above should be considered a minimum test. Where time permits and necessary personnel are available, the following features should be added:

(1) Driving at night with and without lights.
(2) Driving in a convoy.
(3) Cross-country driving.
(4) Driving with a towed load.
(5) Use of the winch and aids to the winch.

353. Final rating.—Circle one of the figures after "Final rating" to give a measure of the driver's performance. This final rating should depend on the errors that have been checked. Obviously, careful judgment by the examiner is of the greatest importance.

DRIVER INFORMATION TEST NO. 2

(For final qualification)

INSTRUCTIONS

Read each question carefully. Select the best answer to each question. On the blank line to the left of the question number, write the letter preceding what you think is the best answer. Notice how the sample is marked.

Sample item

A . The right foot is used to step on the brake pedal.
———— (A) true (B) false

The right foot is used to step on the brake pedal, so the statement is true. Therefore, the letter A has been placed on the blank line preceding the question number.

Mark only one answer to each question.

QUESTIONS

———51. Holding your left foot on the clutch pedal while driving is known as "riding the clutch" and results in—
(A) excessive clutch wear (B) the rear wheels turning more slowly (C) more control over the car (D) easier gear shifting

———52. In backing down a hill, the driver should put the vehicle in neutral.
(A) true (B) false

———53. When skidding on a slippery road, you should—
(A) use the emergency brake (B) depress the clutch (C) steer in the direction in which the rear end is swaying

———54. Hitchhikers, if in military uniform, may be given a ride in an Army vehicle.
(A) true (B) false

———55. Tire pressure should be checked—
(A) daily (B) weekly (C) every other day

———56. To check for leaks the driver crawls under the vehicle while the motor is running.
(A) true (B) false

———57. A cranking motion with the right arm is a signal to—
(A) decrease speed (B) start engine (C) reverse (D) mount vehicle

———58. Cleaning of an Army motor vehicle is the responsibility of the driver.
(A) true (B) false

———59. If the lights change when pedestrians are in the center of the street, the driver should—
(A) wait until the pedestrians are out of the way (B) start before the pedestrians get in the way (C) sound the horn and proceed

———60. In starting up a long grade with an Army truck, you should come to a complete stop before shifting to a lower gear.
(A) true (B) false

———61. In traveling in a convoy, a driver of one of the convoy vehicles may—
(A) pass slower moving vehicles in the convoy (B) pass a vehicle that has engine trouble (C) exceed the local speed limit

———62. When you drive out of a filling-station yard, street traffic on your left has the right of way.
(A) true (B) false

———63. During peacetime an Army driver must obey the same laws as a civilian driver.
(A) true (B) false

———64. When in a single Army truck, you are allowed to pass a convoy without special authority.
(A) true (B) false

———65. The left arm extended at a 45° angle above the horizontal is a signal for—
(A) a right turn (B) a left turn (C) slowing down (D) stopping

———66. If the driver discovers a mechanical condition injurious to further operation of the vehicle while in convoy, he should—
(A) continue at reduced speed (B) drop to the back of the column (C) signal the driver behind for assistance (D) stop and signal for other vehicles to pass

———67. When vehicles of a convoy are halted, they should—
(A) pull onto the shoulder (B) stop in the lane they are in (C) leave 25 feet between vehicles (D) close up bumper to bumper

———68. The distance between vehicles in a convoy should be—
(A) equal to the speedometer reading in yards
(B) twice the speedometer reading in yards
(C) 150 feet

———69. At a halt the driver should first—
(A) rest (B) unload troops (C) inspect the vehicle
(D) talk with other drivers to see if they need help

———70. You should notice what the instrument-panel gages indicate—
(A) each time you visit the filling station
(B) frequently in the course of driving (C) every 500 miles (D) once a week

———71. Blackout lights are always used for travel at night—
(A) true (B) false

———72. The front-wheel drive should be engaged only after a vehicle becomes stalled.
(A) true (B) false

———73. If the rear of your vehicle skids to the right on a slippery road, you should—
(A) apply brakes lightly (B) turn the steering wheel to the right (C) turn the steering wheel to the left (D) hold the steering wheel still

———74. Scales are the only means of determining whether a truck is overloaded.
(A) true (B) false

———75. If the driver ahead of you in a convoy gives the signal to pass, you should pass him.
(A) true (B) false

———76. Convoys are not required to observe local speed laws.
(A) true (B) false

———77. A shift to the lower range should be made at about 25 miles per hour.
(A) true (B) false

———78. The front wheel drive should not be used for—
(A) 6 percent grades on hard roads (B) cross country driving
(C) slippery roads

———79. In small towns it is desirable to park a convoy on a dead-end street.
(A) true (B) false

———80. The maximum load of a truck may be exceeded in an emergency without special authorization.
(A) true (B) false

———81. In crossing ditches, the driver should depend largely on momentum to carry the truck through.
(A) true (B) false

———82. Blackout lights are used primarily to—
(A) make the vehicle visible to others on the highway (B) illuminate the road a short distance ahead

———83. When approaching an unguarded railroad crossing in an Army truck, you should—
(A) slow to 5 mph (B) slow down so a stop can be made if necessary (C) come to a stop, if visibility is restricted (D) stop

———84. During freezing weather, trucks should be parked on brush or weeds in preference to the bare ground.
(A) true (B) false

———85. Brakes should not be applied when the front-wheel is engaged.
(A) true (B) false

———86. Standard Form No. 26 is—
(A) a trip ticket (B) an Army license (C) an accident report form (D) a gasoline ticket

———87. In driving in a convoy at night, you should use—
(A) parking lights (B) upper beam of headlights (C) lower beam of headlights

———88. A closed fist thrust upward from the shoulder several times means to—
(A) shift to higher gear (B) increase space between vehicles (C) load trucks (D) increase speed

———89. The person loading a truck is responsible for its safety until the destination is reached.
(A) true (B) false

———90. An Army truck is normally operated in—
(A) low range (B) high range

———91. For a given speed on the road, the engine runs faster in low range than in high range.
(A) true (B) false

———92. The brake should be applied "off" and "on" when used in descending a long grade.
(A) true (B) false

———93. Extending the left arm horizontally and describing small circles toward the front means to—
(A) increase speed (B) close up (C) make a right turn (D) pass and keep going

———94. When the gas tank is filled, sparks from static electricity are most likely to occur if the nozzle is held in contact with the tank.
(A) true (B) false

———95. The air filter prevents dust from getting into the oil in the crankcase.
(A) true (B) false

———96. Three long blasts of a whistle repeated several times indicates—
(A) approach to motor park (B) dangerous hill ahead (C) grave danger (D) desire to pass

———97. If heavy and light supplies are loaded on the same truck, the heavier supplies should be—
(A) evenly distributed over the floor of the truck (B) placed near the front of the truck (C) placed near the rear of the truck (D) concentrated near the center of the truck.

———98. During freezing weather, all water may be drained by opening the petcock at the bottom of the radiator.
(A) true (B) false

———99. With a front-wheel-drive truck, you are most likely to get stuck if—
(A) both rear wheels are in mud (B) both front wheels are in mud (C) both right wheels are in mud

———100. Trip tickets should be turned in—
(A) at the end of the day (B) once a week (C) at the conclusion of the trip.

TEST ANSWERS

Page 242	Page 243	Page 244	Page 245
A 51.	A 65.	B 79.	B 95.
B 52.	D 66.	B 80.	C 96.
C 53.	A 67.	B 81.	A 97.
B 54.	B 68.	A 82.	B 98.
A 55.	C 69.	D 83.	C 99.
B 56.	B 70.	A 84.	C 100.
B 57.	B 71.	B 85.	
A 58.	B 72.	C 86.	
A 59.	B 73.	C 87.	
B 60.	B 74.	D 88.	
B 61.	A 75.	B 89.	
A 62.	B 76.	B 90.	
A 63.	B 77.	A 91.	
B 64.	A 78.	A 92.	
		D 93.	
		B 94.	

APPENDIX I

PRACTICAL INSTRUCTION IN MILITARY VEHICLE OPERATION

(Outline and guide to scheduling)

Subject No.	Subject	Approximate number of hours	General references	Text reference (TM 21-300)	Operations	Objective
1	First echelon preventive maintenance (schedules 2 to 6).	24 (Not including practice during driving instruction.)	TM 10-545	Section III, Unit 3B, C, D, E.	Inspection, adjustment, and servicing of vehicle parts (in accordance with first echelon responsibilities) after operation of vehicle; before operation; during operation; when at halt; and weekly.	To train students in the detection and correction or reporting of faulty conditions so that vehicles may be ready to roll again on a moment's notice; to develop simultaneously the students' skill in the use of the vehicle tools; and to increase his general knowledge of the purpose and function of the vehicle parts.
2	Tires and wheels	4	TM 31-200	Section III, Unit 3E.	Removal of wheels and tires; replacing wheels and tires; minor tube repairs.	To train students in the mounting and dismounting of various types of tires and wheels and to familiarize them with the general structure of these different types; to instruct students in the patching of tire leaks.
3	First steps in driving	20	TM 10-460, TM 10-1147, FM 25-10.	Section III, Unit 4B.	Starting and warming engine; transmission gear shifting; starting vehicle; double clutching; backing the vehicle; left and right turns; parking in alinement; parking parallel to curb; operating in low gear (transfer case).	To train in the control of the vehicle for effective operation under simple driving conditions; also to develop in students the ability to coordinate the movements of their vehicle with the movements of other vehicles, and simultaneously to acquaint them with the nomenclature and function of vehicle controls, gages, and safety devices.

4	Advanced driving		10	TM 10-460	Section III, Unit 4C.	Turning vehicle around on narrow road; stopping, starting, and backing on grades; observance of traffic signs and signals; right and left turns in traffic; giving the right of way; approaching and passing through intersections; overtaking and passing other vehicles; maintaining safe speeds and following distances.	To perfect the ability to handle vehicles safely and skillfully on the open highway and in city traffic under ordinary conditions.
5	Map reading		2	FM 25-10, TM 10-460, FM 21-25.	Section III, unit 4D.	Drawing map symbols; reading maps and compasses.	To develop in student drivers the ability to use maps and compasses as an aid in the execution of missions.
6	Motor marches and convoys.		24	FM 25-10, TM 10-460.	Section III, Unit 4E.	Close column driving on open highways; open column driving on open highways; close column driving in congested areas; infiltration driving on open highways, in congested areas, and cross-country; motor marching at night and under blackout conditions.	To develop in student drivers the skills and teamwork necessary for effective motor marches of various kinds and under various conditions, including the ability to follow the hand signals commonly used in motor marches.
7	Loads and loading; tarpaulins; rope tying.		4	FM 25-10, TM 10-460. Motor Transport School Text No. 16.	Section III, Unit 4F.	Ascertaining weight of a load and distribution of weight; protection of cargo; lashing loads; placing and securing tarpaulins; removing and folding tarpaulin; rope tying.	To perfect in the driver his ability to carry out his responsibilities with regard to loading and protection of cargo.
8	Difficult driving		24	FM 25-10, TM 10-460, TM 10-1147. Motor Transport School Text No. 16.	Section III, Unit 4H.	Reconnaissance; use of pioneer tool equipment; application, adjustment, removal and maintenance of chains and traction devices; use of rope in place of chains; leaving the road and crossing ditches; crossing boggy ground; crossing bridges; fording streams; ascending and descending steep grades; driving in sandy and loose soil; driving in woods and underbrush.	To develop in student drivers competence in operating their vehicles under considerable difficulties of terrain, using pioneer tools, chains, rope, or traction devices whenever necessary.

PRACTICAL INSTRUCTION IN MILITARY VEHICLE OPERATION—Continued

(Outline and guide to scheduling)

Subject No.	Subject	Approximate number of hours	General references	Text reference (TM 21-300)	Operations	Objective
9	Operation of winch	4	TM 10-460, TM 10-1147. Motor Transport School Text No. 16.	Section III, Unit 4I.	Operation of winch in low-speed and high-speed forward gears; operation of winch in reverse gear; operation of winch with and without the driving wheels in operation.	To develop in student drivers ability to operate the winch as an aid to difficult driving.
10	Use of winch in a variety of difficult situations.	4	FM 25-10, TM 10-460, TM 10-1147. Motor Transport School Text No. 16.	Section III, Unit 4J	Using winch with vehicle anchorage, deadman, multiple anchor stakes, A-frame; utilization of snatch blocks; improvising a winch by means of ropes and dual wheels.	To develop in student drivers the ability to rescue stuck vehicles by the use of the winch and various aids to the winch.
11	Trailer units	8	TM 10-560, TM 10-460.	Section III, Unit 4M.	Attaching and disconnecting trailers by means of lunette and pintle; retracting and lowering landing gear or landing gear wheels; converting semitrailers into full trailers; towing, backing, and parking trailers; ascending and descending grades and rounding curves with trailers.	To develop the ability to attach and disengage semitrailers, trailers, and full trailers; and to acquaint student drivers with the operation of vehicles while towing trailers.

Total number of hours devoted to practical instruction, 128.

NOTE: Subject No. 11 (Trailer Units) is assigned 8 hours on the basis of instruction considered desirable for all drivers. This includes practice in attaching and disengaging trailers, plus demonstration, and possibly limited practice in operation of a tractor-trailer combination.

Such operation is a specialized activity for which considerable training is required, and it is suggested that extensive practice along the lines indicated in the text be reserved for students who have demonstrated superior ability or have had previous experience with trailers.

APPENDIX II

SUPPLEMENTS TO PRACTICAL INSTRUCTION

(Guide to scheduling)

Approximate number of hours for supplementary demonstrations, lectures and discussions, 28.

Subjects involved:

- Introduction to course
- Physical and mental qualities affecting the operation of motor vehicles
- First echelon preventive maintenance
- Types of vehicles; nomenclature and function of vehicle controls, gages, and safety devices
- Advanced driving
- Map reading
- Motor marches and convoys
- Loads and loading; tarpaulins; rope tying
- Driver's trip ticket and performance record, driver's accident report, and motor vehicle operator's permit
- Difficult driving
- Emergency field expedients
- Driving in theater of operations
- Trailer units
- Breaking in a new vehicle

Approximate number of hours for selection of trainees (preliminary testing), 4.

SUMMARY OF TIME ALLOTMENTS

Approximate number of hours for selection of trainees (preliminary testing)	4
Total number of hours devoted to practical instruction	128
Approximate number of hours for supplementary demonstrations, lectures, and discussions	28
Total number of hours for selection and training of military motor vehicle operators	160

APPENDIX III

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TM 21–300

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BY ORDER OF THE SECRETARY OF WAR:

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